NATURE

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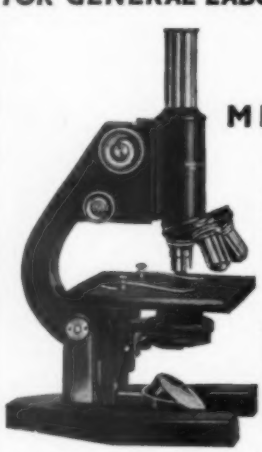

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The Spens Report and Technical Education

WHEN the report of the Board of Education's Consultative Committee on the Education of the Adolescent (afterwards known as the Hadow Report) was noticed in these columns (NATURE, Feb. 5, 1927), we recorded our regret that the position and importance of the junior technical school had not received adequate treatment. No such charge can be made against the Committee's recent report, now already widely known as the Spens report (see also NATURE of January 21, p. 103, and February 18, p. 259, and p. 363 of this issue).

An outstanding recommendation is that there be established a new type of higher school of technical character quite distinct from the traditional academic grammar school, and as a first step towards that end "a number of existing junior technical schools oriented towards the engineering and building industries and any other technical schools which may develop training of such a character as (*a*) to provide a good intellectual discipline altogether apart from its technical value, and (*b*) to have a technical value in relation not to one particular occupation but to a group of occupations should be converted into technical high schools".

It is the intention of the Committee that these schools shall be accorded, in every respect, equality of status with schools of the grammar school type. Clearly, if that intention is to be carried out, there must be equality in respect of the age of entry. Hitherto the age of entry into the junior technical school has been thirteen plus. That has meant that, since the secondary (grammar) schools recruited at the age of eleven, they have had the opportunity of taking the cream of the pupils before the junior technical school could have its chance of selection. If the Committee's recommendation be accepted, that grievance will be removed, for it has agreed "that pupils should be recruited for technical high schools at the age of 11 plus by means of the general selective examination by which pupils are at present recruited for the grammar schools".

That does not mean, however, that at the age of eleven years the curriculum will be what is called 'vocational'. Nor does it mean that, at any time during the course, it will be 'vocational' in its narrowest sense. Indeed, the Committee has been careful to guard in advance against the charge that its views may involve "the danger of premature specialization of a vocational character". It is pointed out, and in our view rightly, that much of the fear of vocationalism has arisen through misunderstanding and failure to define the term and to face the facts of educational development. The Committee underlines a point which had been made more than once in these columns: that, "in any subject worthy of inclusion in a school curriculum, it should be possible to lead the pupil to look beyond the immediate processes in which he is engaged to a wider human and social background"; and if that be not the path towards a really liberal and humane education, we confess that our own views stand in need of considerable revision. With that, and all its implications in mind, the Committee has recommended that the curriculum for pupils between the ages of eleven plus and thirteen plus in technical high schools should be broadly of the same character as the curriculum in other types of secondary schools of equal status. For pupils above the age of thirteen years the curriculum "should be designed so as to provide a liberal education with science and its applications as the core and inspiration".

Let there be no mistake : in making these recommendations the Committee has in mind certain junior technical schools and those alone. There are, under the general heading of schools providing technical education, trade schools, junior commercial schools, junior art departments and home training schools for girls. But, for reasons which the Committee examines with some care, and with which there will be a large measure of agreement, it is not prepared to say that such schools shall become technical high schools.

It may be, of course, that, just as some pupils after two years in a grammar school may be recognized as those who would gain the greatest educational benefit in a technical high school, there will be pupils of the latter who will be recognized as those who will profit most from the education of the grammar school. No system of education can be allowed to develop rigidity without diminution of its full possibilities. We are glad, therefore, to note that the Committee has recommended that there should be close relations between grammar schools and technical high schools, "so that the opportunity of transfer at about the age of 13 should exist for those pupils whose later development would be better suited by an alternative form of education".

Equality of status is further emphasized by a suggestion that the fees for technical high schools should be the same as those in grammar schools in the same administrative area. While fees exist, we believe that is a wise suggestion. We need not here go into the reasons for that belief. It is sufficient to say that there are still people who believe (and they are not altogether to be blamed) that the cost of an article is the truest indication of its value.

Hitherto, the junior technical school has perhaps owed a much larger measure of its success than is usually realized to its freedom from examinations. But, if equality is to be ensured, the present valu e placed by some upon the School Leaving Certificate is not to be neglected. In connexion with that certificate the Committee has expressed itself in terms discussed in NATURE of February 18. While, however, the Committee recommends that technical high schools should have some kind of school leaving certificate which will have general currency and bring before parents, employers and the public generally the fact that these schools are of equal status with the grammar schools, it guards, and very wisely in our view, against the imposition of a rigid external examination. Accordingly it suggests an examination similar to the national certificate examinations, which have worked so well in senior technical colleges and which permit of internal examination with external assessment.

No one would deny that, if the fullest benefit is to be derived from the new technical high schools, their value should be made clear to all. "We find," says the report, "that there is much ignorance and misunderstanding of the aims, scope and work of the technical schools." The modern way of treating a defect of that kind is the way of publicity. The Committee does not shrink from that. "We think that education authorities might be well advised to give greater publicity to the aims and character of their technical schools, both to industry and to the general public. We have already indicated one or two reasons why the general public should know and appreciate more the work of these technical schools ; but there is at least one excellent reason for directing towards them the keener attention of industry."

That reason involves the question of apprenticeship, and we agree with the Committee that this should receive the immediate and earnest consideration of industry. The conditions of apprenticeship should be re-examined if only because there appears to be no uniformity of practice. Some firms will not accept a boy after the age of sixteen years. Some will do so, but insist that his apprenticeship should not end until five years after the date of his entry. Others will accept after sixteen years of age and will remit a period equivalent to that between the date of his sixteenth birthday and the date of his acceptance into industry. Others, still, will remit one year of apprenticeship to a boy who has satisfactorily completed a three-year course at an approved technical school. That, surely, is a position which needs alteration, and we feel with the Committee that it should be considered by employers' associations and by trade unions in order that a definite pronouncement of policy should be made. We do not think the Committee exaggerates when it says "a wise industrialist will be prepared and even eager to take as apprentices boys who have completed a technical school course at the age of 16 plus and should at least grant remission of that period between the sixteenth birthday and the date of actual commencement of apprenticeship, so that in all cases the apprenticeship would be completed on the twenty-first birthday."

It will be observed that, throughout what we have said, there have been no recommendations

affecting the senior technical colleges. That is to be expected, because the senior colleges did not come within the Committee's terms of reference. It may be noted here that the new technical high schools will, where possible, be housed in, and be departments of, technical colleges. The head master of the school will be the head of that department. Even where the school cannot be housed in the college, it is recommended that "its buildings should be linked with buildings of the college in order to facilitate participation in equipment and staff". The school, however, should have its own sub-committee of governors to whom the head master should have direct access.

We welcome the Committee's suggestion of the new technical high school not only because it is needed as part of a unified system of secondary education, but also because it recognizes the liberal quality inherent in technical education, and, in doing so, it faces what it has itself called the facts of educational development. It recognizes the efforts which are being made to evolve a new type of secondary school "providing a liberal education, based on a more realistic and scientific curriculum than that of a grammar school", and in doing so it underlines a point which we have made more than once in these columns: that culture is not necessarily an unchanging quality, but something which may change with the progress of mankind. Perhaps, then, it is not too great an exaggeration to say that, behind the apparently sombre and shapeless civilization which we are making, there lies the possibility of a nobler culture than has yet been known.

Some Seventeenth Century Astronomers

Hevelius, Flamsteed and Halley: Three Contemporary Astronomers and their Mutual Relations. By Eugene Fairfield MacPike. Pp. ix+140+4 plates. (London: Taylor and Francis, Ltd., 1937.) 12*s*. 6*d*. net.

IN this book the editor of the "Correspondence and Papers of Edmond Halley" has brought together brief, straightforward lives of the three great astronomers named in the title; a separate consideration of their commerce together and mutual relations; and, in appendixes, several documents and letters concerning them, chiefly Hevelius. Where the pieces are in Latin a translation has in some, but not in all, cases been furnished by the pen of Mr. A. H. White.

This method of assembling the information set before the reader is not without its disadvantages, for it is bound to lead to either gaps or repetitions. Thus, in the life of Halley, only passing reference is made to the extremely important visit to Hevelius, when Halley tested telescopic sights against the open sights always used by the Danzig astronomer. This matter is dealt with at length in the joint consideration of the three astronomers, while the matter of the piracy, or call it what you will, of Flamsteed's observations is considered, with considerable repetition, in both the separate and the joint life. The book is, perhaps, rather a collection of valuable notes than balanced biography.

In his preface, the author refers to a manuscript autobiography of Flamsteed, preserved at Greenwich, which he has used. This may account for the uneven style of the life, which is a mixture of the modern idiom and typical seventeenth century phrases, taken, we hazard, unchanged from the source, such as, for example, the following: ". . . lent him Sacrobosco's *Spheres*, in Latin, a work which, being perfectly suited to the natural turn of his genius, he perused with uncommon satisfaction", and elsewhere we find "dioptrics" and "Sir Clowdisley Shovell" used in the ordinary text. The life of Halley is much fuller than the others, in accord with the author's special interest. The quarrel between Flamsteed and Halley is discussed at some length, and put down to Flamsteed's jealousy, as in a sense it may have been, but Flamsteed was a man who had suffered many genuine wrongs, who had spent his scanty private means and all his energies freely in the service of astronomy and who had "endured long and painful distempers". Perhaps he was jealous of the genial, social, worldly and successful Halley, who must certainly have been a very much more entertaining companion, but it is a jealousy that may excite our pity rather than our scorn.

The book is of great interest to those concerned not only with the astronomers themselves but also with Hooke, for it was Hooke who in his "Animadversions on the first part of the Machina Coelestis" first insisted on the advantages of telescopic sights over open sights, and clearly explained the nature of optical resolution. The tests which Halley carried out at Danzig with telescopic sights and with the instruments of Hevelius frequently come

up for mention, and they are described at some length, with quotations from Halley's letter, in the part which deals with the mutual relations of the astronomers. Halley was surprised at the agreement which Hevelius could obtain with two different instruments, and implies that angles could be accurately measured to within five seconds with open sights, which seems astounding. He left a testimonial letter with Hevelius which exists in Olhoff's scarce collection, but is, unfortunately, not reprinted here. We could wish that these tests, and the whole question of the accuracy obtainable with the best open-sight instruments, might be discussed in more detail by a practical observer. That Halley could not do better with his telescopic sextant may have been due to a mechanical, as against an optical, inferiority of his instrument.

Halley himself, in spite of his favourable opinion of the observations of Hevelius, soon rallied, with the rest of the learned world, to Hooke's opinion, for while the Danzig visit took place in 1679, we find him writing to William Molyneux in 1686, "The controversy between Mr. Hevelius and Mr. Hook, as you very well observe does, as Hevelius manages the matter, affect all those observers that use Telescope sights, and myself in particular, and it is our common concern to vindicate the truth from the aspersions of an old peevish gentleman, who would not have it believed that it is possible to do better than he has done". This kind of change of tone must be taken into account in considering Flamsteed's estimate of the character of Halley. Flamsteed, writing at about the same time, with the same views, does himself credit with the following generous sentiment: "Nor doe I find myselfe so far concerned in his writings as that I can thinke myselfe obliged to stand up in their defence at this time, hee [Hevelius] is very old, has obliged the World much by his labors, has taken a vast deal of paines and been at great cost to publish them, hee has suffered much of late and it would look like a piece of Inhumanity to vex him with an examination of his workes, under these circumstances".

Mr. MacPike's book is beautified with some excellent portraits, including one of Elisabeth Hevelius, surely the first recorded woman astronomer, the forerunner of Caroline Herschel and so many other illustrious ladies. It has an excellent index of names, and deserves a place on the shelves of students of the seventeenth century.

E. N. DA C. A.

Wild Flowers of Attica

Wild Flowers of Attica
By the late Shirley Clifford Atchley. Prepared for publication by Dr. W. B. Turrill. Pp. xix+60+22 plates. (Oxford: Clarendon Press; London: Oxford University Press, 1938.) 25*s*. net.

MR. SHIRLEY ATCHLEY, long a member of the British Legation at Athens, was a man who published nothing, but enjoyed a scholar's reputation among men of learning. For he knew the paths and the by-paths, the beaten and unbeaten tracks of Greece as no one else did and probably no other man had ever done; and his knowledge was so great as to become almost legendary of the language and its dialects, the folk-lore and not least the field-botany, both of the mainland and of the islands. He dreamed of the books he should write some day; he even planned one on the vernacular names of the Greek plants, but nothing came of it. But he kept on sending plants, rare and common, to Kew until he built up a great herbarium, and the more his reputation grew the more kindly and good-humouredly did he answer the countless questions which men were wont to ask him.

The pretty book before us, based on his own scanty notes and subscribed for as a keepsake by his friends, will so far serve its purpose, and keep in remembrance a learned, lovable and sweet-natured man. It is enriched and beautified by coloured drawings of some seventy or eighty flowering plants, the work of the author's friend and doubtless kindred spirit, Mr. W. O. Everett of Athens. There has been little or no selection here, for many of the plants figured are common familiar things; we feel even a little surprised to see *Cheiranthus Cheiri*, *Smilax aspera*, *Marrubium vulgare* and *Vinca major*, all faithfully portrayed. But after all, the book itself is no catalogue of rarities, and these common things do help somehow among the rest to suggest or recall the flower-carpet of Hellenic spring. The drawings are interesting in another way; for they look like the work of some old sixteenth-century herbalist, Brunfels perhaps, who knew little and cared nothing about the structure of the flower or even the precise outline of a leaf, but just gathered his plant, flowering or seeding, withered or green, and drew it exactly as it came. The mandrake on the frontispiece is a perfect drawing of its kind, and startlingly like this famous plant as one meets it growing by the wayside.

Beautiful as the book is, it saddens one to think how little is saved, how much is lost, of all the author's learning. There is little or nothing new or even strange to botanists and scholars in all these brief and sketchy annotations: even the vernacular names are few, and look odd in plain typography. Save only that a few are noted as Cretan names, there is nothing to show for what Atchley could alone have given us and what we should have so gratefully received, an account of the local plant names in provincial and insular Greece. The ancient name of 'mandragóras' still survives, says Atchley; but I should like to know whether he had ever heard it called γοργονάκι as Unger found it many years ago. Of the forty or more Greek verbascums, only one is figured; we are merely told that "in various parts of Greece species of Verbascum are used as fish-poisons", and, like some other poisonous plants, are called "phlómos": nothing more! Now Aristotle talks of the plant φλόμος as a fish-poison, and Aelian tells how it will rid our ponds of frogs; and Sibthorpe found one of the spurges so used and so called in his time; and Robert Walpole found it used by Albanian settlers at Salamis; and Heldreich found mullein and spurge and daphne and dog-mercury all called by the same name, and perhaps all used in the same way. We may take it for sure and certain that Shirley Atchley, and he alone, could have told us, precisely and adequately, the whole story, what species are used of this genus or of that, and where, and how—but now the rest is silence.

D'ARCY W. THOMPSON.

An Italian Psychologist

La psychologie expérimentale en italie (École de Milan)

Par Dr. A. Manoil. (Bibliothèque de philosophie contemporaine.) Pp. viii+490+16 plates. (Paris: Félix Alcan, 1938.) 80 francs.

THIS book might well have been entitled "The Work of Agustino Gemelli", founder of the Catholic University of Milan and director of its Department of Psychology. As the following sketch of his life indicates, Prof. Gemelli is a remarkable man; in Dr. Manoil he has found a devoted and competent Boswell. After obtaining his doctorate at Pavia both in medicine and in science, he served for five years from 1898 as assistant to the histologist Golgi, carrying out research during this period on the hypophysis of the brain. But in 1903 he turned aside to theological studies and for four years led the life of a Franciscan monk. Then he resumed his scientific work, visiting between 1907 and 1911 the biological and neurological laboratories of Nussbaum and Verworn at Bonn and of Edinger at Frankfort. In 1909 he promoted in Italy the neo-scholastic movement, which had also been introduced into the Catholic University of Louvain, the home of his distinguished colleague in experimental psychology, Prof. A. Michotte. In 1912 he obtained his doctorate in philosophy. Thereupon he began his career as an experimentalist psychologist, working in Germany at the psychological laboratories of Külpe and Kräpelin and carrying out research at the laboratory of Turin under Kiesow. In 1916 he was at Munich studying 'psychological profiles' with reference to occupational selection. On the entry of Italy into the Great War, he joined her army first as doctor and priest, later establishing the first psycho-physiological laboratory of the Italian army, for the study of aviation and the selection of airmen.

With this unique experience, Gemelli founded at Milan in 1921 the Catholic University of the Sacred Heart, which he provided with a large scientific library and with well-equipped biological and psychological laboratories. The latter laboratory he has since directed with remarkable energy, efficiency and versatility. For as Dr. Manoil rightly says, "there is virtually no field in theoretical, experimental or applied psychology which Prof. Gemelli has left untouched". In this volume he attempts to describe these manifold activities, both before the foundation of the Catholic University at Milan and, together with those of his colleagues and students, after its foundation. A bibliography of some 175 published papers is appended, of which by far the majority bear Prof. Gemelli's name. Some of those which are here described, generally in a historical setting, are to be found at full length in the six large volumes of *Contributi* from his laboratory which have appeared between the years 1925 and 1935.

The most important of these contributions relate to (*a*) the use of the psycho-physical method of 'equivalents' in the study of tactual illusions; (*b*) the elaboration, based on new experimental data, of a theory of perception; (*c*) electro-acoustic investigations of speech; and (*d*) the selection of air-pilots. The book also contains shorter chapters describing Prof. Gemelli's anatomical experiments concerning the psycho-physiological factors in emotion, his investigations in animal and industrial psychology, and his

applications of psychology to the problems of physical training. Throughout he insists on the 'finalistic principle', the 'purpose' in view, which directs the 'synthetic activity' of the subject.

Gemelli agrees with Michotte that in perception the fundamental and terminal factor is the apprehension of meaning—an intellectual act so closely bound up with the intuitive, sensorial organization of the data that they are usually only distinguishable under experimental conditions. Cinematographic investigations lead him and his colleagues to distinguish four degrees or phases in the developing perception of form and meaning—(i) of mere 'presence', (ii) of a 'form', (iii) of the apprehension of meaning, (iv) of identification by name. Other investigations are described into perception in peripheral and twilight vision, the perception of ambiguous profiles, etc. Throughout he is far from being a complete adherent to the Gestalt school, although he lays great stress on the function of the 'whole'.

Gemelli's experiments on speech (conducted with his biologist colleague, Prof. Giuseppina Pastori) are based on an analysis of oscillograms, several of which are illustrated in fifteen plates. He insists that each unit—whether 'phonem' (the most elementary unit), word or sentence—is a whole; possessing an individuality which, however, is widely modifiable. Thus a phonem, especially a vowel, will be modified in the oscillogram according to accent, its situation in the word, and the nature of its neighbouring consonants; the vowel is influenced by the syllable, as the syllable is influenced by the word, the 'whole' being pre-existent in regard to the 'part' and determined by meaning and expression. Yet each phonem has a characteristic acoustic structure and an oscillographic form which gives it a specific and recognizable form.

These brief accounts must suffice to illustrate the broad field and the inevitably variable worth of Prof. Gemelli's labours. They deserve the international attention which they will receive by their publication in the present volume.

Birds of Sussex

A History of Sussex Birds

By John Walpole-Bond. Vol. 1 (Raven to Eastern Great Reed-Warbler). Pp. xix+382+12 plates. Vol. 2 (Reed-Warbler to Teal). Pp. vii+384+19 plates. Vol. 3 (American Blue-winged Teal and Red-legged Partridge). Pp. vii+384+22 plates. (London: H. F. and G. Witherby, Ltd., 1938.) 3 vols., £5 5s. net.

JOHN WALPOLE-BOND, a distinguished ornithologist of many years standing, in this his most recent work, in three volumes, has had the assistance as illustrator of Philip Rickman. Between them, author and artist (aided by that high standard of book production which is expected from the firm of Witherby) have produced a work which, it is safe to say, will rank as a standard one on Sussex birds.

The scope of the work can be realized when it is stated that more than four hundred bird species are dealt with. Of that number 112 nest regularly in the county.

Of the fifty-three coloured plates by Philip Rickman which nobly illustrate the work, the three which to some eyes are the most attractive are Montagu's harrier hunting, a shoveler duck and drake, and a male black redstart. The shovelers are portrayed with rare delicacy, and the harrier is shown moving above his feeding haunts; the graceful and buoyant, and yet somewhat furtive flight of the harrier has been caught with rare faithfulness by the artist.

The author in the compilation of this great work has laboured long and faithfully, and he has many interesting records of the birds of the county. He tells us that the raven no longer nests in Sussex, although it still visits the Sussex coast on migration. The peregrine falcon, fierce pirate of the skies, still nests on the less accessible cliffs, the hobby still rears her young in the native woods, and in comparatively recent years a pair of Montagu's harriers nested in the county. Mr. Walpole-Bond does not say whether these birds succeeded in hatching their second clutch—the first was taken—but presumably he did all in his power to see that these rare eggs escaped the collector.

The peregrine is, it is interesting to learn, a bird which sometimes nests so near to villages that the rubbish from the dust-bin chute almost sprays the eggs:

> The eyrie was—for the site has long since crumbled away, as chalk often will—only some fifteen feet down the steep on a long, broad bench which culminated in the chute down which the dust-bin refuse from the adjoining village was shot once a week; and the eggs were habitually laid only a foot or two from the chute itself. On this ledge could always be seen every conceivable sort of rubbish, and in 1905 in the eyrie itself, and almost touching its contents, reposed an oblong strip of cardboard. (Vol. II, p. 247.)

Of the supposed aerial climb of the swift into the sky of a summer evening he has something to say. It has been suggested by some ornithologists

that the swifts on occasion spend the night in the air, sleeping lightly as they soar at great heights above the earth. But Mr. Walpole-Bond, from many nocturnal vigils in the Horsham belfry, is convinced that swifts do return to roost after this evening flight to high altitudes. He has seen some of the merry-makers rush home at about 10 p.m. G.M.T., but all the birds were not home until after midnight—that is 1 a.m. by British Summer Time. These valuable observations show that the eyesight of swifts must be extremely good, as the bird must make an entry, flying at full speed, into its narrow nesting hollow during the darkest hour of the summer night.

In his chapter on the swift Mr. Walpole-Bond mentions the astonishing pertinacity of life in a click beetle. The author was handling a juvenile swift which in its agitation disgorged a click beetle. In two hours the limp, moist 'corpse' had completely revived, although it had been caught in the mouth of the parent swift and had perhaps been carried a considerable distance, and had then been given to, and swallowed by, the young swift.

Writing of the autumn migration of the swift, the author mentions a single swift seen in Sussex on October 28, 1906. This calls to the reviewer's mind that he and his wife watched for some time a pair of swifts flying backwards and forwards over the leafless birches at Aviemore on the Spey Valley in Inverness-shire, where the river bed is 700 ft. above the level of the sea, on November 11 of a recent year. That day was unusually mild, yet the Cairngorm Hills were already thickly coated with their winter snowfall, and there was severe frost a few days before, and again almost immediately after, these wandering swifts were seen. Whence they had come, and how they had survived the frost was unknown, and we sometimes wondered whether their subsequent migration south had been successful.

It has of course been proved that swifts do on occasion become torpid in their nesting hollows in spring if severe weather should catch them after their arrival at their nesting haunts, but so far as is known, there is no record of their having been found in this condition in autumn. S. G.

Chemistry of the Brain

Chemistry of the Brain
By Dr. Irvine H. Page. Pp. xvii+444. (London: Baillière, Tindall and Cox, 1937.) 34*s*.

INTEREST in the biochemistry and physiology of the nervous system is increasingly being taken, not only by purely scientific investigators, but also by clinicians, psychiatrists and many of those who come into contact with the abnormal manifestations of the nervous system. Dr. Page's book has an appeal to all such workers, and presents a real stimulus to those for whom mental activity—normal and otherwise—is associated with the dynamic equilibria taking place in the brain.

The book commences with a brief biography of Thudicum, "the founder of brain chemistry". It passes on to a survey of our present knowledge of the sterols, the importance of which in the make-up of the brain is well known but of the significance of which in brain metabolism we are as yet ignorant. The chemistry of the phosphatides is next considered, and then Dr. Page turns to such subjects as fatty acid metabolism, cerebrosides, carbohydrates and nitrogenous metabolism. The subjects are dealt with briefly but sufficiently adequately to present the most significant findings to the clinical research worker and to those whose main interest is the study of the brain.

There are omissions, and in places the subject-matter is out of date; but this is inevitable in a book which does not pretend to be a text-book of biochemistry and in a subject where advances are made so rapidly. Wherever possible Dr. Page keeps the clinical aspects well to the foreground, and one of the most valuable features of the book is the description of clinical findings in psychiatry and their possible interpretations in the light of our knowledge of the biochemistry of the nervous system. Effects of oxygen deprivation, of alterations in calcium ion concentration, of deprivation of magnesium and manganese, of the action of narcotics and drugs are a few of the many subjects which are considered. There is a brief survey of the parts played by the vitamins in maintaining the integrity of the nervous system, and the penultimate chapter (by Dr. J. H. Quastel) is devoted to a description of oxidations of the brain with a very brief survey of the present (that is, until 1936) situation concerning oxidations in the living cell.

References to original articles—clinical and otherwise—are copious. Much information is present which is not elsewhere readily available, and the book is a boon to biochemical and physiological workers in the psychiatric domain.

The book is well produced, but there is a fair number of misprints and incorrect formulæ.

Introduction to Bessel Functions

By F. Bowman. Pp. x+135. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1938.) 10s. 6d. net.

THIS book is designed to provide a readable introduction to the subject for non-mathematical specialists. Beginning with functions of zero order, the author sets forth in a clear and straightforward manner the solutions of Bessel's equation of zero order. The student is thus introduced not only to $J_0(x)$, but to Neumann's Bessel function of the second kind of zero order, and this leads to the general solution. The properties of the functions are then considered as far as the use of the Fourier-Bessel expansion, and some valuable illustrations of their application are made to the vibrating membrane and the hanging chain.

The modified function of zero order is next discussed and well applied to the flow of an alternating current in a wire of circular cross-section. Then follows a brief consideration of the simplest definite integrals involving $J_0(x)$, such as those of Parseval, Lipschitz and Weber, which are applied to the problem of the electrostatic potential of an electrified disk. The next chapter is devoted to asymptotic expansion with as much relevant theory as is essential to an intelligent understanding of the need for such expansion. Finally comes a clear, though brief consideration of the Bessel functions of any real order with an exposition of their chief properties. This is followed by some interesting applications, including Kepler's problem, the critical length of a thin uniform elastic rod clamped vertically and the normal modes of vibration of a circular membrane with its circumference fixed.

Each section contains some well-chosen exercises for the student's use and there is a useful index. The book is excellently printed with some clear diagrams, and should certainly prove very useful not only to students of physics and engineering, but also to mathematical students in general. F. G. W. B.

Plant Growth-Substances:

their Chemistry and Applications, with Special Reference to Synthetics. By Hugh Nicol. Pp. xii+108+4 plates. (London: Leonard Hill, Ltd., 1938.) 3s. 6d.

PLANT growth-promoting substances are now becoming of increasing importance not only to the research physiologist but also to the practical horticulturist. It has been the topic of international conferences and of discussions held at the Royal Botanic Gardens, Kew, and elsewhere.

Though full of information of value to the research worker, Dr. Nicol's book will prove of even greater value to the professional horticulturist. The subject-matter is based on a series of articles published in the *Manufacturing Chemist*. The following subjects dealt with in the book will appeal to students: synthesis of growth substances; results of work on the effect of such substances; growth-substances from natural sources; some constituents of urine; chemistry in relation to growth; classification, nomenclature and identification of growth substances. The practising horticulturist will find these well-written chapters of interest and value also, and he is offered still further help in the first two chapters. The tabular index at the end is very useful.

Dr. Nicol is to be congratulated on a very useful book which his publishers have issued at a reasonable price. It can be strongly recommended to students of, and research workers in, plant physiology, and to the horticulturist who is alive to the opportunities which scientific research is offering him to his advantage.

Cataloguing in Special Libraries:

a Survey of Methods. By John L. Thornton. Pp. xii+268. (London: Grafton and Co., 1938.) 10s. 6d. net.

THIS book, by the assistant librarian of St. Bartholomew's Hospital, will interest all librarians who have charge of special collections. It is an investigation of the cataloguing methods used in various types of special library—national, government, university, learned society, commercial, technical and school—with examples of how their special difficulties are met. Representative libraries of each type are dealt with in detail. In addition there are chapters on alphabetization, treatment of serial publications and co-operative cataloguing.

The survey reveals a great diversity of cataloguing systems and a great shortage of cataloguing staff. Mr. Thornton's comments are shrewd and at times outspoken. He does not, happily, belong to the school which aims at transforming librarianship from a useful art to an arcane science. His style is clear, concise and free from jargon, and he keeps the library user always in the foreground. The book is illustrated with specimen card and other catalogue entries. Except for some minor details, it is well produced and printed. B. S.

Varieties of British Butterflies:

a Selection of Rare and Interesting Specimens of Aberrations, including Gynandromorphic and Homoeotic Forms; Albinism and Melanism. By F. W. Frohawk. Pp. 200 (48 plates). (London and Melbourne: Ward, Lock and Co., Ltd., 1938.) 42s. net.

MR. FROHAWK'S object is apparently to figure rare and interesting varieties and other unusual forms, including gynandromorphs, of British butterflies. In so far as this object is concerned, the task has been well carried out. Mr. Frohawk is a highly skilled entomological artist and the forty-eight colour plates illustrating this book bear ample testimony to his artistic ability. Abnormal forms of butterflies have, in recent years, become highly prized by collectors and consequently fetch considerable prices at auction sales. For the collector, therefore, this work is certainly admirable. We regret that a book so highly priced should contain very little scientific information on the subject treated. The real student who desires to know something regarding modern views as to the underlying causes producing these remarkable 'forms' will have to go elsewhere for information.

Cause, Purpose and Economy of Natural Laws*

Minimum Principles in Physics

By Prof. Max Born

WITHOUT claiming to be a classical scholar, I think that the earliest reference in literature to the problems which I wish to treat here is contained in Virgil's "Aeneid", Book I, line 369, in the words "taurino quantum possent circumdare tergo."

When Dido landed at the site of the citadel of Carthage, she opened negotiations with the inhabitants for some land and was offered for her money only as much as she could surround with a bull's hide. But the astute woman cut the bull's hide into narrow strips, joined them end-to-end and with this long string encompassed a considerable piece of land, the nucleus of her kingdom. To do this she had evidently to solve a mathematical question—the celebrated 'problem of Dido': to find a closed curve of given circumference having maximum area. We do not know how she solved it, by trial, by reasoning, or by intuition. In any event, the correct answer is not difficult to guess: it is the circle. But the mathematical proof of this fact has only been attained by modern mathematical methods.

In saying that the first appearance of this kind of problem in literature is that quoted above I am not, of course, suggesting that problems of minima and maxima had never occurred before in the life of mankind. In fact, nearly every application of reason to a definite practical purpose is more or less an attempt to solve such a problem: to get the greatest effect from a given effort, or, putting it the other way round, to get a desired effect with the smallest effort. We see from this double formulation of the same problem that there is no essential distinction between maximum and minimum; we can speak shortly of an 'extremum', and 'extremal' problems.

It was during Isaac Newton's lifetime, at the end of the seventeenth century, that geometrical and mechanical problems of extremals began to interest mathematicians, and shortly after Newton's death (1727) the metaphysical idea of purpose or economy in Nature was linked up with them.

One of the simplest examples is the optical 'law of reflection' which can be expressed as a minimum principle: the beam of light from a point P_1 to another point P_2 selects just that reflecting point Q which makes the total path P_1Q+QP_2 as short as possible. The light behaves as if each beam had a tendency to contract, and the French philosopher, Fermat, has shown that all the laws of geometrical optics can be reduced to the same principle. Light moves like a tired messenger boy who has to reach definite destinations and carefully chooses the shortest way possible. Are we to consider this interpretation as accidental, or are we to see in it a deeper metaphysical significance? Before we can form a judgment, we must learn more about the facts and consider other cases.

The straight line is the shortest connexion between two points in space. But if we travel on our earth, we can never go exactly in a straight line since the earth's surface is not plane. The best we can do is to follow a great circle, which is the curve in which the sphere is intersected by a plane passing through the centre. The globe, however, is not an exact sphere, but is slightly flattened at the poles and bulges at the equator. What, then, about the shortest line on such a surface?

Gauss hit on this problem when occupied with a geodetic triangulation of his country, the electorate of Hanover. He attacked the problem from the most general point of view and investigated the shortest lines on arbitrary surfaces. But in remembrance of his starting point he called these lines 'geodesics'. They are in many ways of fundamental importance for physics.

Let us consider a point P on a surface and all curves through P which have the same direction at P. It is evident that there is among them a 'straightest curve', that is, one with the smallest curvature. Hence the geodesic can be characterized by two somewhat different minimum properties: one which can be called a 'local' or 'differential' property, namely, to be as little curved as possible at a given point for a given direction; and the other, which can be called 'total' or 'integral', namely, to be the shortest path between two points on the surface.

This dualism between 'local' and 'total' laws appears not only in this simple geometrical problem, but also has a much wider application in physics. It lies at the root of the old controversy whether forces act directly at a distance (as assumed in Newton's theory of gravitation and the older forms of the electric and magnetic

* Substance of the Friday evening discourse delivered at the Royal Institution on February 10.

Fig. 1.

theories), or whether they act only from point to point (as in Faraday's and Maxwell's theory of electromagnetism and all modern field theories).

There seems to be no objection to extremal laws of the local type; but those of the integral type make our modern mind feel uneasy: although we understand that the particle may choose at a given instant to proceed on the straightest path, we cannot see how it can quickly compare all possible motions to a distant position and choose the shortest one—this sounds altogether too metaphysical.

But before we follow out this line of thought, we must convince ourselves that minimum properties appear in all parts of physics, and that they are not only correct but also very useful and suggestive formulations of physical laws.

One field in which a minimum principle is of unquestionable utility is statics, the doctrine of the equilibrium of all kinds of systems under any forces. The centre of gravity tends to descend as far as possible; to find the configuration of stable equilibrium, one has only to look for the minimum of the height of the centre of gravity. This height, multiplied by the force of gravity, is called potential energy.

A chain hanging from both ends assumes a definite shape, which is determined by the condition that the height of the centre of gravity is a minimum. If the chain has very many links, we get a curve called the catenary. It can readily be shown by means of a heavy chain, the centre of gravity of which is marked by a construction of light levers, that disturbance of the equilibrium of the chain in any arbitrary way causes the centre of gravity of the chain to rise.

Fig. 1 illustrates an example where gravity competes with another force, elasticity. A steel tape is clamped at one end and carries a weight at the other. This weight is pulled downwards by gravity, while the tape tries to resist bending in virtue of its elasticity. This elastic force also has a potential energy; for a definite amount of work must be done to bend the tape into a given curved shape. Now there are definite positions of equilibrium in which the total energy, that of gravitation plus that of elasticity, is as small as possible. Generally there are two such positions. Changing the clamping angle carefully, a position is found when a jump suddenly occurs from one position to another on the opposite side. This instability is determined by the condition of minimum energy. We can summarize the facts connected with the limits of stability by drawing a graph, Fig. 2, not of the elastic lines themselves, but by plotting the angle of inclination against the distance from the free end. We obtain wave-shaped curves, all starting horizontally from the line representing the end carrying the weight. These curves have an envelope which separates the regions in which one or several curves are going through each point, and calculation shows that this envelope is just the limit of stability. We shall return to this example later when discussing the minimum principles of dynamics.

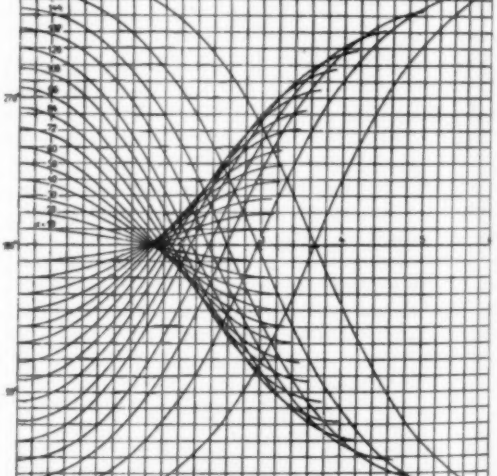

Fig. 2.

Another example of the statical principle of minimum energy is provided by soap bubbles. Soap films have the property of contracting as much as possible; the potential energy is proportional to the surface area. Therefore soap films are surfaces of smallest area, or minimal surfaces. Nature is an expert mathematician, quickly finding the solution.

These experiments are not merely pretty toys without serious background. They have been chosen only for the sake of illustration. The real importance of the principle of minimum energy can scarcely be exaggerated. All engineering constructions are based on it, and also all structural problems in physics and chemistry.

Models of crystal lattices provide examples of this. A crystal is a regular arrangement of atoms of definite kinds in space. Now the models representing the crystal lattices of two chemically similar compounds, namely, common salt (NaCl) and cæsium chloride (CsCl) are different in structure. Why are they different? Because, as the cæsium atoms are much larger than the sodium atoms, the potential energy differs in the two cases and its minimum is attained for different configurations.

Considerations of this kind, more or less quantitative, enable us to understand a great number of facts about the internal structure of solid matter.

Before we proceed to the consideration of minimum principles in dynamics, where the situation is not as clear and satisfactory as in statics, we must first mention another part of physics which in a sense occupies an intermediate position between statics and dynamics. It is the theory of heat, thermodynamics and statistical mechanics.

There is a very important extremum principle, discovered by Lord Kelvin, which governs irreversible processes: a quantity called 'entropy' increases in the process and has a maximum for the final equilibrium state. It is not easy to describe this miraculous entropy in terms of directly observable quantities, such as volume, pressure, temperature, concentration, heat. But its meaning is immediately obvious from the point of view of atomic theory. A model will facilitate the explanation. Take a flat box like a little billiard table into which marbles can be put. If I carefully place them in the right-hand half, I have a state of partial order; if I shake the box they spread out over the whole box and attain a configuration of lower order. If I throw some marbles into the box one after the other so that their position is purely accidental, it is very improbable that they will all fall in the right-hand half. One can easily calculate the probability of a uniform distribution over the whole box as compared with one in which the majority of the marbles is in the right half; and one finds overwhelming odds in favour of the uniform distribution. Now the statistical theory of heat interprets the entropy of a system with the aid of the probability of the distribution of the atoms, and the tendency of entropy to increase is explained by the obvious fact that states of higher disorder have a higher probability.

Let us now come back to the minimum principles of dynamics.

The first problem of this kind—first both in historical order and in order of simplicity—was formulated at the end of the seventeenth century by Johann Bernoulli of Basle, one of a great family which produced many famous scholars and especially mathematicians. It is the problem of the curve of quickest descent or brachistochrone: given two points at different levels, not in the same vertical line, to determine a connecting curve in such a way that the time taken by a body to slide without friction under the action of gravity from the higher point to the lower is a minimum —compared of course with all possible curves through the two points. With a model having three paths, namely, a straight line, an arc of a circle and an intermediate curve known as a cycloid, it can be shown that it is not the straight line on which a rolling ball arrives first, nor the steep descent of the circular arc, but the cycloid. If you were to try with any other curves, you would always find the same result, for the cycloid has been constructed according to the theoretical calculation.

The determination of this brachistochronic property of the cycloid was a very satisfactory piece of mathematics. It attracted much attention, and there is no philosopher of this period who did not test his analytical powers by solving similar extremal problems. Another member of the Bernoulli family, Daniel Bernoulli, developed at the beginning of the eighteenth century the minimum principle of statics and applied it to the catenary and the elastic line. Encouraged by these successes, he raised the question whether it was possible to characterize the orbit, and even the motion in the orbit, of a body subject to given forces—for example, a planet—by a minimum property of the real motion as compared with all other imagined or virtual motions. He put this question to the foremost mathematician of his time, Leonard Euler, who was very much interested in it and found, in the autumn of 1743, a solution which he explained with the help of various examples in a book published in 1744. It is the basis of the *principle of least action* which has played so prominent a part in physics right up to the present time.

The history of this principle, however, is an amazing tangle of controversies, quarrels over

priority and other unpleasant matters. Maupertuis, in the same year, 1744, presented a paper to the Paris Academy of Sciences in which he substituted for Fermat's optical principle of the shortest light path, which we have already discussed, a rather arbitrary hypothesis, and extended the latter, in 1746, to all kinds of motions. He never gave a satisfactory proof of his principle (which is not surprising as it is incorrect), but defended it by metaphysical arguments based on the economy of Nature. He was violently attacked by Chevalier d'Arcy in Paris, Samuel König from Bern and others, who showed that if Maupertuis's principle were true, thrifty Nature would be forced in certain circumstances to spend not a minimum but a maximum of action! Euler, whose principle is quite correct, behaved rather strangely; he did not claim his own rights, but even expressed his admiration for Maupertuis's principle, which he declared to be more general. The reasons for this attitude are difficult to trace. One of them seems to have been the publication by König of a fragment of an alleged letter of Leibniz in which the principle was enunciated. The genuineness of this letter could never be proved, and it seems probable that it was a forgery designed to weaken Maupertuis's position. This may have brought Euler over to the side of Maupertuis, who was at this time president of the Berlin Academy and a special favourite of the king, Frederic II, later known as the Great. The dispute was now carried over into the sphere of the court of Sanssouci and even into the arena of politics. Voltaire, friend of Frederic, who heartily disliked the haughty president of the Academy, took the side of the 'underdog', König, and wrote a caustic pamphlet, "Dr. Akakia", against Maupertuis. But the king, although he thoroughly enjoyed Voltaire's witty satire, could not sacrifice his grand president and was compelled to defend Maupertuis. This led at last to the disruption of their friendship and to Voltaire's flight from Berlin, as described in many biographies of Frederic and of Voltaire.

The curse of confusion has rested for a long period on the principle of least action. Lagrange, whose work was the culmination of the development of Newton's dynamics, gives an unsatisfactory formulation of the principle. Jacobi restricts it in such a way that the minimum condition determines the orbit correctly; the motion in the orbit must be found with the help of the energy equation. This was an important step. But the spell was at last broken by the great Irishman, Sir William Rowan Hamilton, whose principle is mathematically absolutely correct, simple and general. At the same time, it put an end to the interpretation of the principle expressing the economy of Nature. For there is, by a kind of fortunate mathematical coincidence, a statical problem for which the statical minimum principle for the potential energy coincides formally with Hamilton's principle of least action for the pendulum; this statical problem is the loaded steel tape considered before. The curves representing the angle of inclination of the elastic line as a function of the distance from the free end are exactly the same lines as those representing the angle of deflection of the pendulum as a function of time (see Fig. 2).

Now we have seen that only those regions of the graph which are simply covered by the lines correspond to a real minimum, a stable configuration of the elastic line. There are other regions, those beyond the envelope, where two or more lines pass through a given point. Only one of those lines corresponds to a real minimum. But both represent possible motions of the pendulum. Although the conditions at the ends of the elastic tape do not correspond exactly to those at the ends of the time interval in Hamilton's principle, there is this fact in common: if the length of the tape or the corresponding time interval in Hamilton's principle for the pendulum exceed a certain limit, there is more than one possible solution, and not each of them can correspond to a true minimum, though to a possible motion. In this way we come to the conclusion that the actual motion is not in every case distinguished by a genuine extremal property of action but by a less obvious mathematical property called 'stationary' configuration.

Thus the interpretation in terms of economy breaks down. We may regard the idea of finding purpose and economy in natural laws as an absurd piece of anthropomorphism, a relic of a time when metaphysical thinking dominated science.

The importance of Hamilton's principle lies in a different direction altogether. It is not Nature that is economical, but science. All our knowledge starts with collecting facts; but proceeds by summarizing numerous facts by simple laws and these again by more general laws. This process is very obvious in physics. We may recall, for example, Maxwell's electromagnetic theory of light, by which optics became a branch of general electrodynamics. The minimum principles are a very powerful means to this end of unification. The ideal would be to condense all laws into a single law, a universal formula, the existence of which was postulated more than a century ago by the great French astronomer, Laplace.

If we follow the Viennese philosopher, Ernst Mach, we must consider economy of thought as the only justification of science. I do not share this view—there are other aspects and justifications of science. But I do not deny that economy

of thought and condensation of the results are very important, and I consider Laplace's universal formula as a legitimate ideal. There is no question that the Hamiltonian principle is the adequate formulation of this tendency. It would be the universal formula if only the correct expressions for the potential energy of all forces were known. Nineteenth century thinkers believed more or less explicitly in this programme, and it was successful in an amazing degree.

By choosing a proper expression for the potential energy, nearly all phenomena could be described, including not only the dynamics of rigid and elastic bodies, but also that of fluids and gases, as well as electricity and magnetism, together with electronics and optics. The culmination of this development was Einstein's theory of relativity, by which the abstract principle of action regained a simple geometrical interpretation. The motions of the planets can be considered as 'geodesics' in the four-dimensional space formed by adding time to our common space. Einstein's law of gravitation, which contains Newton's law as a limiting case, can also be derived from an extremum principle in which the quantity that is an extremum can be interpreted as the total curvature of the space-time world.

We call this period of physics which ends with the theory of relativity the classical period, in contrast to the recent period which is dominated by quantum theory. The new quantum mechanics assumes that all laws of physics are of statistical character. The fundamental quantity is a wave function which obeys laws similar to those of an acoustical or optical wave; it is not, however, an observable quantity, but determines indirectly the probability of observable processes. The point which interests us here is the fact that even this abstract wave function of quantum mechanics satisfies an extremum principle of the Hamiltonian type.

We are still far from knowing Laplace's universal formula, but we may be convinced that it will have the form of an extremal principle, not because Nature has a will or purpose or economy, but because the mechanism of our thinking has no other way of condensing a complicated structure of laws into a short expression.

Science at the Golden Gate Exposition

By Science Service, Washington, D.C.

A SUPER-SPECTACLE of science at work is unfolded at the Golden Gate International Exposition, the World's Fair of the West, at San Francisco, which was opened on February 19. Treasure Island itself is an engineering triumph, for it is entirely a man-made island in San Francisco Bay, 400 acres in area. After the close of the fair, the buildings will be razed and the island will become the San Francisco-Bay Area airport; already Pan-American Airways clippers to the Orient use the island as the home port. From the hunt for subatomic particle of tiniest size to wondering about the course of a distant star, from war on death-dealing virus too small to be seen under an ordinary microscope to giant engineering projects like man-made Treasure Island itself, science dominates the 50,000,000 dollar show.

Only one hall bears the identifying label, "Hall of Science", but the entire exposition is as much a demonstration of the research worker's genius and accomplishments as this single building. Student of biology or of physics, layman or lover of the spectacular—all will find what they want in this twentieth-century panorama. Rats are thriving on synthetic food, insect friend of man battles insect foe, two liquids become artificial rubber, a machine talks in words that never issued from a human throat—all this happens and much more during the 288 days the fair will be open.

The keynote of the entire science display is an exhibit which cost a quarter of a million dollars, prepared by the University of California. Among the exhibits of particular scientific interest are the following. (*a*) 'Test tube' plants, grown by scientific workers of the Plant Nutrition Division of the University of California in a demonstration of the most significant contribution of agricultural science to modern farming—'soilless farming'. Just as Pan-American Airways is doing on tiny Wake Island to supply fresh vegetables to clipper passengers and crews and as California planters are now learning, tomatoes and other truck products are grown in water containing nourishing chemicals instead of in soil. Spectators will see for themselves the tremendous yields made possible by this method. (*b*) Californian men of science show in a specially constructed chamber just how harmful noise can be to the human organism, and what can be done about it. (*c*) No playthings are a set of dolls which are displayed. They teach the curious thousands how mother and father pass on their characteristics to their

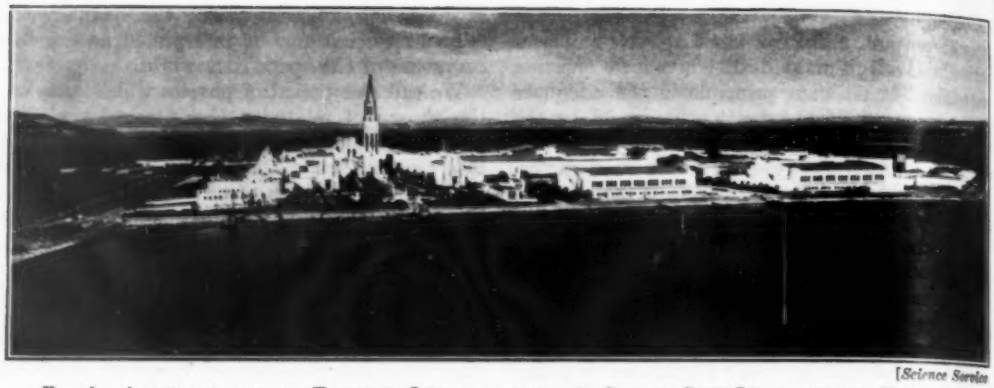

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FIG. 1. A GENERAL VIEW OF TREASURE ISLAND, SITE OF THE GOLDEN GATE INTERNATIONAL EXPOSITION, AND THE EXPOSITION BUILDINGS.

children. Colour of eyes is the specific characteristic traced in the set of exhibition mannequins. (*d*) The University of California, where Prof. Ernest O. Lawrence, of cyclotron fame, is a faculty member, is a world centre of research into the secrets of the atom. So it is to be expected that a model of the world's and California's greatest cyclotron should be there.

California's biggest academic institution, however, is not the only science exhibitor. Pan-American Airways is staging a great aviation show by demonstrating the operation of the clippers that fly to China and the Philippines. Small boys face plenty of competition from their elders for space behind the glass partition in Pan-American Airways' great new hangar. On the other side, 'grease monkeys' and members of crew and passengers go about their business. Treasure Island has become the new San Francisco base for the airline that flies the Pacific, and all operations will be visible for the duration of the Fair. After December 2, closing day, and after the exhibit buildings have been removed, other airlines will transfer their headquarters from Oakland Airport and Mills Field on the San Francisco side of the bay to this single skyport.

Riches of the earth and the miner's art are shown in a synthetic mountain, Treasure Mountain, which visitors enter through a 'valley' between two 'mountain ranges'. Every type of mining operation on different key ores of the mineral-laden West is shown in working form—a 2,500-miles science trip in a few minutes. The peak is 50 ft. high and 400 ft. long.

Anthropologists and archæologists will find assembled unbelievably old treasures, dating back to earliest times, from the countries bordering the Pacific. Stone axe heads forty-nine centuries old from Siam, and gorgeous specimens of the goldsmith's art in the Chimu culture that preceded Peru's highly civilized Incas of four hundred years ago, that have added to man's store of knowledge concerning himself, are shown on Treasure Island.

The Federal exhibit, which cost one and a half million dollars, shows activities of the National

[Science Service

FIG. 2. TREASURE ISLAND JUST BEFORE BUILDINGS, TREES, SHRUBS AND FLOWERS AND EXHIBITS BEGAN TO BE MOVED ON TO THE ISLAND.

Government, as they affect citizens, around seven central themes. One, for example, displays in dramatic form what Uncle Sam does for Mr. Average Man from birth through old age—how, for example, Public Health Service grants provide better maternity care and how the Social Security Board now provides for a man in his declining years.

Indians demonstrate their handicrafts in the Federal building. Not only do they show their unique art, but also they may start a vogue for Indian handicrafts among visitors. Planners of the exhibit certainly hope so, for such a boom would prove a boon to the Red man, who has not had an easy row to hoe in adapting himself to the white man's civilization.

Chemical wizardry, as practised by industrial giants whose ever-new products enter into everyone's life every day, are also shown. The Dow Chemical Company shows how it makes ocean water yield up magnesium, the lightest metal now in use, and iodine and bromine, two vital chemicals which enter into, among other things, the old stand-by antiseptic and photographic film respectively.

A chemist pours the clear contents of one beaker into another and a gummy substance, which is then moulded into proper shape, results. It is allowed to solidify, and, lo! a rubber tyre. How chemistry makes for better living in this and in other ways is shown by E. I. du Pont de Nemours and Co.

An 'iron lung', about which much has been heard recently and which has saved many lives, is there. Visitors have a chance to watch one at work in a model hospital erected by Dr. Gabriel Barnett.

In charge of the vast science programme in the Hall of Science alone has been Dr. Milton Silverman. Co-operating with him as exhibitors he has had some of the foremost scientific institutions in the United States. Harvard University, the Mayo Clinic, the Jackson Clinic and the American Medical Association, to mention only a few, are taking part. More than two hundred and fifty industrial exhibits, of which many are science shows all by themselves, are represented.

Technical Education in Great Britain

AS was to be expected, the principal discussion at the annual meeting, held in London on February 24–25, of the Association of Technical Institutions, centred around the recommendations with regard to technical education put forward in the Spens Report. Sir Henry Steward, chairman of the City and Guilds of London Institute, who has succeeded Sir Robert Pickard as chairman of the Association, presided over the meetings, which were held in the Hall of the Merchant Taylors Company.

The discussion was opened by Principal J. Paley Yorke, one of the signatories to the Report, and chairman of the Council of the Association. He said that the general trend of the Report has been aptly expressed by one commentator as "a shifting of the basis of education from one of *social habit* to one of *natural aptitude*". Who should say that a parent should not take account of the social implications which attach themselves to a child by attendance at one school or another? But if some equality of status can be secured between schools of different educational types the parent will no longer find himself forced to weigh social esteem against educational provision. He need only think of the fitness of the curriculum for the aptitude and the inclinations of the child. The text of the Report on the inside title-page is "Chacun doit être à portée de recevoir l'éducation qui lui est propre." The recommendations endeavour to make that possible.

Mr. Paley Yorke then went on to describe and explain the findings of the Committee set out in Chapter viii—"Technical High Schools and other Technical Schools". He pointed out that the terms of reference made it necessary for the Committee to give a detailed consideration of the aims, objects and work of those schools called Junior Technical Schools and to determine their actual and potential relation to secondary schools of other types. This is the first time in history that so complete an examination has been made by so important a Committee. The members of the Committee found it necessary to collect a large body of evidence, and they visited a number of representative schools to obtain for themselves a true picture of their work, of the staffing, equipment and corporate life. The Committee was greatly impressed through these visits and was the better able to assess the oral and written evidence received. It recognized that there are two main groups of Junior Technical Schools in existence—one frankly and definitely preparing its pupils for entry into a specific occupation and developing in them a substantial measure of personal skill in the processes of that occupation—the other providing an educational foundation and background with science and its applications as the core and inspiration of the curriculum for those whose broad intention it is to enter industry without reference to any particular occupation within it. It came to the very definite conclusion that the schools of this second

group are capable of developing, and indeed already had developed in a large degree, a form of secondary education which ought to be regarded as an alternative to that of a Grammar School.

From this the Committee made its now famous recommendation that a new type of school should be established to be called a Technical High School —to be accorded in every respect equality of status with schools of the Grammar School type, yet to be wholly distinct from them. As a first step it was recommended that a number of these Junior Technical Schools at present providing a curriculum based on the engineering and building industries should be converted into Technical High Schools. The recommendation carried with it the provision of a minimum course of five years with a recruitment at 11 plus years, the recruitment based on the method of the general selective examination by which children are recruited for the Grammar Schools, the ultimate selection being determined in accordance with the choice of the parents, the report of the head of the contributing school and the result of interviews.

It was considered essential, of course, that the curriculum of the 11 plus to 13 plus pupils should be broadly of the same character as that in other secondary schools so that there could be another age point, *in all schools*, namely 13 plus, at which transfers should, if desirable, be made—equally for eliminating misfits, and for the encouraging of aptitudes which might have emerged and for allowing a change of choice on the part of the parents.

Several points emerged from the recommendations, and Mr. Paley Yorke made special reference to the question of the housing and staffing of the Technical High Schools, because he feels that there has been much misunderstanding about it and much non-understanding criticism from established secondary school quarters.

The Consultative Committee had no doubt whatever that the special value of the Technical High School depends upon its contact with the equipment and with the staff of a Technical College. The examples were before it. The evidence was there. The experiment has been conducted for more than thirty years with the 13 plus to 16 plus group, and there is no doubt at all about the results. Therefore it said that where possible Technical High Schools should be housed in the Technical Colleges and Technical Institutes and should be a department of the College, and the head master of the School would be head of that department. It is recognized, however, that the discipline, the corporate life and the general conduct of the school are necessarily distinct from those of the College, and that for these the head master should be responsible. It is also considered an *essential* feature of the Technical High School that it should have some use of some of both the equipment and the staff of the College. Thus the head master of the School will have certain staff units wholly under his direction and will also have other members of the college staff working for him for a portion of their time, but who are not full-time members of the *school* staff. These teaching units will be attached to the College under the direction of one or other of the several heads of the departments of the College.

This organization of a Technical College into departments is not known in the secondary school world—and that accounts for the non-understanding of the essential condition that the principal of the College must secure and maintain the co-operation of the several heads of the specialized departments and their staffs, and the use of the laboratories, shops and special equipment, in the work and the life of the school.

There need be no fears about all this. It has been in operation for years and it is completely successful. The Committee is satisfied that—provided that a sub-committee of the Governing Body be appointed to manage the school and the head master has direct access to it, and the appointment of staff engaged exclusively in the work of the school be made in consultation with him—the organization of a Technical College through its principal and heads of departments allows a sufficient measure of autonomy to the head masters of the Technical High Schools whilst securing that vital contact of the School with the staff and equipment of the College which it regards as of primary importance.

Finally, in his review, Mr. Paley Yorke dealt with the vitally important recommendation of a form of school-leaving certificate based on internal examinations—assessed by approved assessors and endorsed by the Board of Education. As a body, the Association is familiar with certificates of this form through the now well-known and highly successful National Certificates and Diplomas. He is glad indeed that the Committee had been able to state so clearly that it does not seek to impose upon the Technical High Schools any system of external examination, with the necessarily rigid syllabus which would inevitably follow in its wake.

In the course of the subsequent discussion—a discussion which was carried over to the next morning—criticism came from those interested in education for commerce that the Committee has not recommended the establishment of Technical High Schools with a curriculum based on commercial education. Mr. Paley Yorke replied that the Committee had taken the view that, as at present constituted, the Junior Commercial Schools recruiting at 13 plus and 14 plus are more directly

comparable with those Junior Technical Schools preparing their pupils for entry to a specific occupation. Their usefulness and functions are not denied. He pointed out that this decision was based on the evidence received, but that though the door has at present been closed against their becoming Technical High Schools, it has not been locked or bolted; and indeed might be said to be slightly ajar. In reply to other points raised, he pointed out that it was recommended that the word 'Junior' should be discontinued and that the official designation should be *Technical Schools* for the two and three-year course schools and *Technical High Schools* for the others; but it was also recommended that each school should have its own local name.

Obituary Notices

Prof. Karl Schröter

THE nestor of Swiss botanists, Karl Schröter, emeritus professor in the Federal College of Technology, Zurich, died on February 7 in his eighty-fourth year. Up to the last he was physically and mentally active, and so recently as January 28 he delivered a public lecture to a leading scientific society in Zurich. Unfortunately, after a brief attack of pneumonia following upon influenza, his long and active life came to a sudden end.

Karl Schröter was born in 1855 in Esslingen in Germany, where his father was then chief engineer in a large engineering establishment, but later appointed professor of engineering in the Federal College of Technology, Zurich. At this institution, his son Karl, who acquired Swiss nationality, commenced his studies of natural science and came under the stimulating influence of Karl Cramer, who persuaded him to devote himself to the study of botany. Two years after graduation in 1876, he established himself as *Privat Dozent* and a few years later he was invited to give a course of advanced lectures in place of Prof. Heer, who was taken seriously ill. He proved himself to be such a successful lecturer that on the death of Prof. Heer he was appointed, at the age of twenty-eight years, to the vacant professorship, which he held for forty-two years.

Schröter had been influenced in his botanical studies by his predecessor, choosing for his doctor's thesis the examination of some fossil woods collected by Heer in the far north.

Schröter was, however, more interested in living plants, and as an assistant he took an active part in the organization of botanical excursions for the students, by which means he acquired a very wide and varied acquaintance with the Swiss flora, which characterized his later work both as a teacher and as an investigator. In 1889, he published a pocket-flora of alpine plants which was translated into both French and English. He was, however, specially interested in the relationship of plants to their surroundings, and thus was one of the founders of the modern study of ecological botany. After many years work on alpine meadows and moorlands, he published, with the assistance of other botanists, in six parts during the years 1904–8 his "Plant-life in the Alps", a very comprehensive study of alpine vegetation. At the same time, he was collaborating with J. Früh in the production of a monumental volume on the bogs of Switzerland. He did not, however, confine himself to flowering plants, but paid attention to the plankton flora of the Swiss lakes and published several accounts of the periodicity of some of its algal forms.

In 1898, Schröter undertook a journey around the world, visiting the United States, Honolulu, Japan and Java. The result of his trip made him an enthusiastic supporter of the movement to organize international phytogeographical excursions, and in connexion with these he visited both Great Britain and the United States. Though already ageing in 1923, he organized and led a party of plant geographers through the Swiss Alps. By that time, the Swiss National Park had been established in the Lower Engadine, and Schröter, who had been keenly interested and active in its establishment and had taken part in its botanical exploration, naturally included it in the itinerary of the excursion.

Schöter's many-sided botanical labours received due recognition both in Switzerland and abroad. He was elected a foreign member of the Linnean Society of London in 1925 and delivered the Hooker Lecture of the Society in 1926. His lively and charming personality gained him many friends at home and abroad, not a few in England, which he visited on several occasions.

He married in 1884 a fellow student, Margaret Middelberg of Amsterdam, who died in 1925. Five years later he married Mrs. Teterode, by whom he is survived.

F. E. WEISS.

Prof. J. Versluys

THE death is announced, at the age of sixty-six years, of the eminent Dutch zoologist, Prof. Jan Versluys, professor in the University of Vienna.

Versluys was a fine, tall man, with a fluent command of English, German and French, and was well known to, and highly respected by, many British zoologists who met him either abroad or in Great Britain on the occasions when he attended the meetings of the British Association. He was a pupil of his life-long friend the late Prof. Max Weber of Amsterdam.

As a young man, Versluys accompanied Max Weber as a naturalist on the memorable voyage of S.S. *Siboga* on its marine exploration of the seas of the Malay Archipelago during 1899–1900, and on

his return to Holland wrote the monographs on the two families of the Gorgonacea—the Chrysogorgiidæ and Primnoidæ—collected by the Expedition. The care he took in the description of the species, his skilful illustrations and his references to type specimens, which he examined whenever available, have rendered these monographs of extraordinary value and interest. They are still the standard works on the subject. After the completion of his work on these cœlenterates, he turned his attention to the study of the skull of reptiles and published his first paper on the morphology of the columella bone before he left Amsterdam. In 1904 he migrated to Germany and became a *Privat Dozent* and later an assistant professor in the University of Giessen, and during the following ten years he produced several papers on the skulls of recent and fossil reptiles bearing on what he called "Das Streptostylie Problem", or the mobility (kinetism) of the bones of the jaws on those of the brain case.

At the outbreak of the Great War, Versluys remained in Germany, but after the occupation of Belgium by the German army he was appointed a professor in the Flemish University in Ghent and remained there until the Armistice. Returning to Holland, he made a home in the beautiful town Hilversum and there he began a study of another subject, which he called "Das Limulus problem". Working in collaboration with R. Demoll, of Munich, a number of papers were published on the appendages and other structures of recent and extinct Arachnoidea, especially of *Limulus* and the other Merostomata.

The general conclusions reached by these authors were startling in their originality but have not been accepted by most of the zoologists in Great Britain. They suggested that the evolution of *Limulus* was on lines exactly the reverse of those suggested by Sir Ray Lankester in his well-known essays on this subject. *Limulus* was derived, according to their view, not from an aquatic but from an air-breathing, tracheate ancestry; and, moreover, that even the Crustacea are descended from a remote terrestrial group of animals of which *Peripatus* is the only living representative.

After a few years in Holland, Versluys accepted the position of professor in the University of Vienna and remained there until his death. I have not been able to find any record of his original work in this last period of his life, except an abstract of a paper he read at the British Association meeting in 1934, on the distribution of the Primnoidæ with reference to the Wegener hypothesis.

He leaves a widow and three children.

SYDNEY J. HICKSON.

Eng.-Commander J. J. Walker

THE death on January 12 of Eng.-Commander James John Walker will be deeply regretted by very many British naturalists, especially by students of his favourite insects—Coleoptera and Lepidoptera.

Elected in 1878, Walker had been for some years the senior fellow of the Royal Entomological Society of London, and was president in 1919 and 1920, his two addresses being on "The Fringes of Butterfly Life" and "Some Aspects of Insect Life in New Zealand" (*Proc.*, 1920 and 1921). Two of his papers in the *Transactions* of 1890 and 1895 dealt with Lepidoptera from the Straits of Gibraltar and the butterflies of Hong Kong, respectively, while the *Proceedings* (1907–31) includes many of his interesting notes on British and a few on foreign insects. The vast majority of his observations made on voyages and at home appeared, however, in the *Entomologist's Monthly Magazine*, of which he became editor in 1904, on the death of Robert McLachlan. The first of his notes and papers in this excellent journal—more than three hundred in number—appeared in 1872, and the last, dated December 20, 1938, less than a month before his death, was published in January. It records the more interesting of fully three hundred species of Coleoptera which he had observed in about thirty acres of meadow and cultivated land between his house and the River Cherwell.

Among Walker's papers were many on interesting subjects which he always kept in mind and added fresh records as they came to light. Such were his notes in 1908, 1911, 1912, 1928 and 1931, on immigrant insects which invaded Great Britain; in 1922, on butterflies which have reached Iceland and on the Lepidoptera of North Atlantic islands; in 1931, on insects at sea; in 1914, 1915 and 1928, on the Monarch butterfly, *Danaus plexippus*, and its migrations. Among the many British localities from which he published records the most frequently named are, Isle of Sheppey, Sheerness, Chatham, Kent, Portland, New Forest and especially Oxford, which became his home in May 1904. The honorary M.A. was conferred on him by the University in the following year.

Walker was a constant visitor to the Hope Department of Entomology in the University Museum, Oxford, where he gave immensely valuable help in describing, arranging and recording the historic collections. He joined the Ashmolean Natural History Society in 1904, became president in 1913–14 and from 1911 onwards was editor of the *Proceedings*, in which he published (1907–30) a valuable list of Oxford Coleoptera with supplements; also twenty-three interim reports (1911–38), the last four including Lepidoptera in addition to Coleoptera.

The above is a very condensed account of some of the chief publications of one who, in spite of his great age—eighty-seven years—retained to the very end his wonderful memory, keen interest and the never-failing desire and ability to help his brother-naturalists.

E. B. POULTON.

Prof. Albert Sauveur

PROF. ALBERT SAUVEUR, emeritus professor of metallurgy in Harvard University, whose death occurred recently in Cambridge, Mass., was a Belgian by birth, but was long known as the leading teacher of metallurgy in the United States.

Born at Louvain in 1863, he studied in the School of Mines of Liège, and later crossed the Atlantic to enter the Massachusetts Institute of Technology,

where he graduated in 1889. His first post was as chemist to the Pennsylvania Steel Co.; but after a year he was chosen to take charge of the research laboratory of the Illinois Steel Co. in Chicago. From that time onwards he carried out many researches on iron and steel, making great use of microscopical methods, a field in which there were still few workers. His first paper on the microstructure of iron and steel appeared in 1893 and had many successors. In 1905, he was appointed to the chair of metallurgy at Harvard, which he occupied until his official retirement in 1935, with an interval from 1917 until 1919, during which he acted as director of the Metallurgy Division of the Air Service in France, work recognized by his appointment as a Chevalier of the Legion of Honour.

Sauveur's investigations were concerned almost exclusively with the metallurgy of iron and steel, especially with the problems of hardening and of deformation. His contributions, clearly expressed and admirably illustrated, have played an important part in the development of the subject. In 1898 he founded a journal, the *Metallographist*, which became the medium for the publication of much original work from many countries. Although it lasted only for five years, being then absorbed into another journal, its volumes are often consulted by students. His text-book, "The Metallography and Heat Treatment of Iron and Steel", which first appeared in 1912, has passed through several editions, and is greatly valued. A few years ago he discussed, in the form of a dialogue, the current views on controversial questions in metallurgy.

Sauveur's department at Harvard was small in comparison with the metallurgical departments of many universities and colleges; but the quality of its work was excellent, and many of the ablest American research workers in that field received their training there. He had great charm of manner as well as great gifts of exposition, and was revered by metallurgists as one of their leaders. Even in his retirement he continued to be active, and only last year he initiated a movement with the object of simplifying the description of the microscopic constituents of steel, which he considered to have been obscured by unnecessarily complex hypotheses and cumbrous terminology.

Sauveur received many honours from technical societies, including the Bessemer Medal of the Iron and Steel Institute in 1924. He married, in 1891, Mary Prince Jones, of Massachusetts, and had two daughters.

C. H. D.

Mr. Reynold Bray

MR. REYNOLD BRAY, who lost his life by drowning last September, was an Arctic explorer of considerable achievement and much promise. In 1931, he was with the Oxford University Exploration Club's Expedition to Akpatok in Ungava Bay, Hudson Strait. This expedition, on which Bray was nominally photographer, made a complete survey of this hitherto little-known island. The story was told in "The Isle of Auks" by N. Polunin, 1932. In the following year Bray, with T. H. Manning, made a winter tramp through Swedish, Finnish and Russian Lapland from Bodo to Murmansk. Bray recounted this fascinating journey, which included trouble on the Soviet frontier, in "Five Watersheds" (1935). In the following year he was again with Manning, in Southampton Island and Melville peninsula mapping much of the eastern shores of those lands as well as the unknown coast of Baffin Island on the east of Foxe basin.

In 1938, Bray planned with P. Baird to continue his exploration of the western coast and the interior of Baffin Island. Ice, however, interfered with the ship's progress and eventually the two men were landed on the south-east of Melville peninsula, whence they set off in their boat last August in an attempt to reach Igloolik Island, 300 miles to the north at the eastern entrance to Fury and Hecla Strait. Some forty miles south of the island, on September 14 last year, Bray was blown out to sea in a canvas boat and lost.

Mr. R. Kanthack

THE late Mr. Ralph Kanthack, who died in his seventy-seventh year at Golders Green, London, on November 12, was chiefly known for his great ability in scientific translations in English and German. He was educated in Hamburg and Lüneberg, Germany, taking an honours degree in engineering. After some period as a marine engineer, he found himself more attracted to scientific and optical studies, and became associated with Messrs. Carl Zeiss, when he had the advantage of intimate association with Abbe, Czapski and others. This led to his establishment as a London agent for Messrs. Carl Zeiss and Messrs. E. Leitz; but in addition to business activities he was known as an authority on various aspects of microscopy.

In later years, Kanthack began the literary work which brought him well-deserved recognition. He translated and revised a German edition of Prof. Heath's work on geometrical optics ("Lehrbuch der Geometrischen Optik". Berlin: J. Springer, 1894), and during the Great War he translated von Rohr's "The Theory of Optical Instruments" at the request of the British Government. Later, he was associated with Messrs. Adam Hilger, Ltd., for whom he prepared a book in two volumes entitled "Tables of Refractive Indices".

Mr. Kanthack was the eldest son of the late Emilio Kanthack, at one time British Consul of Para, Brazil, and brother of the late Prof. Alfredo A. Kanthack, an authority on pathology. He was much respected in optical circles for his outstanding character.

WE regret to announce the following deaths:

Prof. A. P. Coleman, F.R.S., emeritus professor of geology in the University of Toronto, an authority on Canadian metalliferous deposits, on February 27, aged eighty-six years.

Prof. Henry Louis, emeritus professor of mining and William Cochrane lecturer in metallurgy in Armstrong College, Newcastle-upon-Tyne, on February 22, aged eighty-three years.

News and Views

Prof. F. J. Cole, F.R.S.

PROF. F. J. COLE will be retiring from the chair of zoology in the University of Reading in September next, after a tenure of thirty-two years. Prof. Cole built up the Zoology Department from very small beginnings; to-day the University can regard with pride the results of his work and inspiration. The Museum of Comparative Anatomy, though small, is without a rival among those of the younger universities, and the preparations, dissections and models have been executed in the Department. Even the printing of the labels is done there. This Museum has justifiably achieved widespread fame; recently a former keeper of zoology in the British Museum (Natural History) referred to it as the "gem" among British museums of comparative anatomy. Although assisted by a very small, but efficient staff, the organization of the teaching side of the Department has always been of the first class. Until comparatively recently, few students entered a university with even the most elementary knowledge of zoology; but those who were fortunate enough to study the subject at Reading soon became infected with the enthusiasm of Prof. Cole and his staff, and by far the majority became sincere students of the subject, not merely candidates reading for an examination.

PROF. COLE'S researches on the nervous system and lateral line system of fishes and on the general morphology of the myxinoid fishes are well known. In recent years his strong literary bent, scholarly mind and acquisitive love of books have combined to interest him in the history of zoology. He has lectured and written on the biologists of the past, extending to them the same sympathetic understanding of their difficulties and mistakes that he offers to young people struggling along the paths of original investigation under his care, yet always, after the manner of Gibbon, relieving the tedium of instruction with an apt analogy or an appropriate anecdote. Last year, with the collaboration of Mr. Robert Gibbings, he produced a facsimile reprint of a very rare book—"Observationes Anatomicae Selectiores. Amstelodamensium. 1667–73" (see NATURE, 142, 235; 1938). His researches into the writings of Leeuwenhoek and Swammerdam have taken him to the old towns and museums of Holland. As a result several papers have appeared in the *Annals of Science* and other journals devoted to the history of science. As Prof. Cole will now be able to devote all his time to his unique collections of early medical books we look forward to more of his delightful studies of the biologists of the past.

Prof. Otto Hahn

ON March 8, Prof. Otto Hahn, director of the Kaiser Wilhelm-Institut for Chemistry, at Dahlem near Berlin, will reach his sixtieth birthday. To mark this event, a special number of the *Zeitschrift für physikalische Chemie* will appear, in which all the articles will be contributed by members of his laboratory. A celebration of a more intimate nature is also contemplated in the Institute itself. Prof. Hahn's friends in other countries, among whom are many readers of NATURE, will wish to join with his colleagues in offering their warmest congratulations. To workers and students in the field of radioactivity the names of Otto Hahn and Lise Meitner are almost indissolubly linked together. Readers of NATURE will remember that Frl. Lise Meitner celebrated her sixtieth birthday last November, and it is most fitting that where one has led the other should not be far behind. Prof. Hahn's first work in radioactivity was an investigation of the activity of thorianite, carried out under Ramsay at University College, London. This work led to the discovery of a new radioactive substance, radiothorium. Attracted by the rapidly growing fame of Rutherford, he then went to Montreal for a year (1905–6). There he discovered a new body, radioactinium, in the actinium series and showed that there were marked similarities between the products of thorium and actinium. On his return to Berlin, there followed the discovery of mesothorium and some striking experiments on the use of the recoil phenomenon as a method of separating radioactive products. It was at this time that his association with Frl. Meitner began. Together they examined the radiations from many radio-elements and later, with von Baeyer, they discovered the presence of homogeneous groups in the β-radiation of some products, the first indication of the now well-known β-ray spectra.

Hahn and Meitner also made investigations on the origin of the actinium series and, in 1918, they discovered, simultaneously with Soddy and Cranston in Great Britain, the immediate parent of actinium, protactinium. Later Hahn prepared this new element in a pure state in quantity sufficient for an atomic weight determination. In pursuing his investigations of the disintegration products of uranium, Hahn found a very curious branching of uranium X_1, which gave rise to two bodies—uranium X_2, already known, and uranium Z, a new product of the same mass and charge as uranium X_2 but with different radioactive properties. This was in fact the first example of a pair of nuclear isomers, many of which have recently been found as a result of artificial transformations. In recent years, much of Prof. Hahn's work has been devoted to a study of the artificial transformations resulting from the bombardment of uranium and thorium by neutrons. Only a few weeks ago he was able to show, on chemical evidence, that one of the products of the disintegration of uranium was not, as previously supposed, an isotope of radium but an isotope of barium, pointing to a really dramatic disintegration of the uranium nucleus. This startling conclusion has been confirmed by very striking

experiments in New York, Paris and other places. It will be evident from this very brief account of his work that Prof. Hahn's contributions to radioactivity have been of outstanding importance. He has also taken a prominent part, with his students and colleagues, in developing methods of studying chemical problems by the use of radioactive indicators.

Dr. C. D. Darlington

DR. C. D. DARLINGTON has been appointed to succeed Sir Daniel Hall as director of the John Innes Horticultural Institution, Merton. Dr. Darlington was educated at St. Paul's School, Hammersmith, where he was a Foundation Scholar, and the South-Eastern Agricultural College, Wye. He went to the John Innes Horticultural Institution in 1923, in Dr. Bateson's time. Here his interest was attracted to chromosome studies by the late W. C. F. Newton. As the importance of this kind of work in relation to breeding became recognized, it was considerably extended at the John Innes Institution, and in 1937 Dr. Darlington was appointed head of the Cytology Department. In 1929, he travelled to Persia and Transcaucasia to investigate the origin of cultivated forms of *Prunus* and *Tulipa*. During 1932–33, he worked in the United States for eight months as a Rockefeller Foundation Scholar, visiting Japan and India on his way home. In the winter of 1937–38, he was a delegate to the Indian Science Congress jubilee meeting. He is at the present time acting as recorder to the Cytology Section of the International Genetical Congress. Dr. Darlington, who is well known for his work in the field of genetics and cytology, has published "Chromosomes and Plant Breeding" (1932), "Recent Advances in Cytology" (1932; second edition 1937), "The Evolution of Genetic Systems" (1939), together with numerous scientific communications. He is a collaborating editor of the new journal *Chromosoma* (see p. 372 of this issue). The appointment takes effect from October 1, 1939.

Mr. James Henderson

THE Iron and Steel Institute has awarded the Bessemer Gold Medal to Mr. James Henderson. The Bessemer Medal was founded by Sir Henry Bessemer, and is awarded annually for distinguished merit in promoting the technical and metallurgical development of the iron and steel industry; it is the highest honour which the Institute can give. Mr. Henderson was associated for forty-five years with the technical development of the Frodingham Iron and Steel Co., Ltd., in North Lincolnshire and held all positions from chief metallurgist to managing director. During that period, the works became one of the most important in the country, and were associated with such important developments as the introduction of the Talbot direct metal process, the use of blast-furnace gas in blowing and power engines, and the installation of modern plate mills. Mr. Henderson is now deputy chairman of the renamed Appleby-Frodingham Steel Co., Ltd., and a director of the United Steel Companies, Ltd.; he is past-president of the British Iron and Steel Federation and of the Lincolnshire Iron and Steel Institute. He is one of the only two Englishmen whose services to the industry have been recognized by nomination to honorary membership of the Verein deutscher Eisenhüttenleute.

Ludwig Mond, F.R.S. (1839–1909)

LUDWIG MOND, patron of the arts and sciences, was born on March 7, 1839, and the commemoration of his centenary is a convenient opportunity to recall something of what we owe to him. Originally German and later a naturalized British subject, he perfected and established in Great Britain the ammonia-soda process which brought into being the firm of Messrs. Brunner, Mond and Company, the nucleus of Messrs. Imperial Chemical Industries, Limited. He also devised satisfactory processes of nitrogen recovery and for the manufacture of producer gas, which latter process is the property of the Power Gas Corporation. No less well known is Ludwig Mond's process for the production of pure nickel, in which a newly discovered and unique compound immediately found important technical application. Throughout his life, he was pre-eminent as a chemist and investigator. His amassing great wealth was the result and not the object of his work.

SOME of Ludwig Mond's public benefactions for the encouragement of scientific investigation may be recalled. During his life he gave £100,000 for the founding and endowment of the Davy Faraday Laboratory of the Royal Institution, and £16,000 for the continuance and improvement of the catalogue of scientific papers of the Royal Society. He bequeathed £50,000 to the Royal Society "for the endowment of research in Natural Science more particularly but not exclusively in Chemistry and Physics". He also bequeathed a similar sum to the University of Heidelberg and £25,000 to Cassel, his native town in Germany. He gave to the nation, together with an endowment for its maintenance, the Mond Collection, chiefly of early Italian paintings, now well known as an important part of the National Gallery. This, and his bequest of £20,000 to the Münich Akademie der bildenden Künste, are memorials to Ludwig Mond's own appreciation of art and to the care he took that others should benefit by it. Truly, this was a great man.

Frederick Howard Marsh (1839-1915)

HOWARD MARSH, an eminent London surgeon and master of Downing College, Cambridge, was born on March 7, 1839, at Homersfield, near Bungay, Suffolk, the son of a gentleman farmer. He received his medical education at St. Bartholomew's Hospital, where he was a contemporary of Alfred Willett (see NATURE, 139, 61; 1937) and qualified L.S.A. and M.R.C.S. in 1861. Five years later he became F.R.C.S. and was appointed surgeon to the Queen Square House of Relief for Children with Chronic Disease of the Joints. In 1868, he was elected assistant surgeon to the Great Ormond Street Hospital for Sick Children, where he afterwards became full surgeon and consulting surgeon. Between 1865 and

1870 he acted twice as private assistant to Sir James Paget, several of whose works he afterwards edited. From 1873 until 1891, when he became full surgeon, he served as assistant surgeon to St. Bartholomew's Hospital, where he lectured on anatomy, practical surgery and orthopædics. In 1903 he was appointed professor of surgery at Cambridge in succession to Sir George Murray Humphry, who had died in 1896, and in 1907 succeeded Dr. Alexander Hill as master of Downing College. He was the author of "Diseases of the Joints" (1886), which went through three editions and was translated into German, "Clinical Lectures and Essays" (1902) and numerous contributions to *St. Bartholomew's Hospital Reports*. Besides the distinctions already mentioned, Marsh was an honorary fellow of the Royal Academy of Medicine in Ireland, president of the Clinical Society of London and a corresponding member of the Orthopædic Society of New York. He died on June 24, 1915. A sympathetic obituary notice by Sir D'Arcy Power, accompanied by his portrait, appeared in *St. Bartholomew's Hospital Reports* (51, 1; 1915).

The Bastardy (Blood Tests) Bill

IT is to be hoped that the Bastardy (Blood Tests) Bill, which was given its second reading after a debate in the House of Lords on February 8 (NATURE, Feb. 18, 294), will duly pass into law. The use of blood group tests has already become a common practice in several other countries, notably Sweden, Germany and the United States. The Bill provides that the Lord Chancellor may make rules under the Act, governing the taking, identifying and posting of blood samples, the form of certificate to be given, the qualifications of the 'approved persons' who make the tests, and the scale of fees payable. It may be pointed out that the *M* and *N* tests require much more skill in determination than the *A* and *B*. It would therefore seem desirable for a local practitioner to take the samples as arranged and send them to one of a very limited number of experts who would make the actual tests. The Galton Laboratory is one of the very few places where the *M* and *N* as well as the *A* and *B* tests are constantly being made as a routine operation. In Denmark, a Government laboratory has been established for the purpose, where the tests are made for a small charge. Probably a similar arrangement would be best for Great Britain.

Television in Cinemas

THE practical application of television moved a step forward on February 23, when a view of the whole progress of the British light-weight boxing championship was transmitted from the Harringay arena. On this occasion, for the first time, the television programme was relayed to three cinema theatres in the West End of London, where the public had paid for admission. A report in *The Times* states that two of these theatres used Baird apparatus, while the third used the Scophony system. These cinemas became in effect overflow meeting places, where those unable to watch the fight in the arena could still follow its progress in black and white pictures; and the view so provided on a fifteen foot screen was the equivalent of a ring-side seat. At the transmitting end, two cameras were used, one giving a general view of the ring with the spectators scarcely visible in the surrounding darkness, while the other gave a close-up view of the two boxers. The latter was used most of the time and enabled viewers to watch the detailed progress of the contest. With the exception of one or two occasions, when there appeared to be a loss of synchronism in the transmitted pictures, the apparatus worked quite satisfactorily, and the accompanying running commentary was up to the usual high standard for sound broadcasting. The successful transmission of this fight demonstrated that such an event is very suited to television, and that the inevitable technical difficulties of relaying the programme to cinemas have been largely overcome. As a result, according to a further announcement in *The Times*, Baird television apparatus is to be installed in some 350 cinemas controlled by the Gaumont-British Picture Corporation.

University of Birmingham: Annual Report

IN the report of the Council which was presented to the Court of Governors at its annual meeting on February 23, reference is made to two recent benefactions, namely, one of £10,000 by Sir Charles Hyde and the other of £2,000 by the Pro-Chancellor and Mrs. Barrow. These were given as peace thank-offerings. Sir Charles Hyde's gift, to be applied to a purpose chosen by the Prime Minister, is to be known as the Neville Chamberlain Physical Fitness Fund, and the income is to be used towards the maintenance of the University's scheme for physical education. The contribution of Mr. and Mrs. Barrow is to be added to the Medical School building fund. Mrs. Ellen M. Parrott has given £500 in memory of her late husband, to be known as the T. H. Parrott Geological Research Fund, for "advancement of research in Geology". Dr. and Mrs. Edward Cadbury, who recently provided funds for the building of the St. Francis Hall, have given a further sum of £3,000, the income of which is to be used for the maintenance of the Hall. As part of the scheme for physical education, a gymnasium (with ancillary rooms and three squash courts and one fives court) is to be built at a cost of £15,000, of which £10,000 has been promised by the University Grants Committee and £5,000 by a private benefactor. Funds for the establishment of a department for research into mental diseases in the new building of the Medical School have been guaranteed for a number of years. The laboratories are now occupied, and Dr. Stanley Barnes has been appointed honorary director of mental diseases research, with Dr. F. A. Pickworth as senior research officer. Several investigations into cancer, financed by the Local Committee of the British Empire Cancer Campaign, are being carried out in the new Medical School. The Poynting Memorial Lecture is to be given on March 7 in the Physics Department by Dr. H. B. G. Casimir, of Leyden, on "The Approach to the Absolute Zero of Temperature, and the Properties of Matter at the

Lowest Attainable Temperatures". The Huxley Lecture is to be given on March 16 at the University, Edmund Street, by Sir Albert Seward on "Aspects of Evolution in the Plant World".

Vocational Rehabilitation of the Physically Disabled

A STUDY of the vocational rehabilitation of the physically disabled has been prepared for the Advisory Committee on Education by Lloyd E. Blanch (U.S. Government Printing Office, Staff Study No. 9). The study reviews the development, status and problems of the rehabilitation service inaugurated in July 1920 by the Federal Government, under which up to June 30, 1937, 98,690 persons had been rehabilitated. In the year ended June 30, 1937, vocational rehabilitation was completed for 8,691 men and 2,400 women, about 60 per cent of whom received some training. Maintenance was provided or secured for 948 while they were undergoing rehabilitation. Of those rehabilitated, 64 per cent were less than thirty-one years of age and only 8 per cent were more than fifty. Most of those rehabilitated (61 per cent) were without dependants, but 26 per cent had two or more dependants. Orthopædic disabilities handicapped 75 per cent of those rehabilitated. The study suggests that 150,000 persons each year acquire permanent disabilities sufficiently serious to prevent them from returning to work without assistance. About 50,000 of these can be employed normally after rehabilitation; 75,000 can be employed only in sheltered workshop conditions, while the remaining 25,000 can only be employed, if at all, in their homes. Accordingly the present programme only rehabilitates about 20 per cent of the physically disabled who need such assistance. The study concludes that a permanent Federal programme is required and insists on the importance of Federal administration and of the co-ordination of Federal services which affect vocational rehabilitation. Reference is also made to special services for the blind and to the need for an extended programme, including the provision of living expenses during rehabilitation.

The New Deal in the United States

IN *Fact* of October 1938, under the title "Roosevelt and his New Deal", Stephen K. Bailey gives a concise account of the achievements of the New Deal up to the end of September, which indicates not merely the problems which faced Roosevelt but also the background of social and economic conflict against which they have to be assessed. In successive chapters, the attempts made to meet the needs of the farmer, under the Agricultural Adjustment Administration and the Farm Credit Administration, etc., the industrialist, under the National Industrial Recovery Act and the Public Works Administration, as well as the needs of labour and the unemployment situation by the Federal Relief Administration, are surveyed. The complexity of the situation is clearly indicated as well as the way in which the conflict between big business interests and labour has been intensified, the difficulties which the Federation has to overcome in the direction of social reform, the establishment of a really sound banking system, and the problem of the Supreme Court. Mr. Bailey hazards no guess as to the outcome of the present situation: the successes and failures of the New Deal are impartially indicated as well as some of the reasons for the vagaries of American foreign policy; but his account, whether or not it is used as an introduction to further study, should at least contribute to the sympathetic understanding of the American situation, although the rather sombre picture he gives of the relation between employers and employees and of the attitude of the former to social reform does not encourage optimism.

Selection of Sizes of Timber Beams

THE determination of the suitable breadth and depth of a timber beam to carry a given load involves consideration of strength, of stiffness, and of the capacity of the material to withstand the horizontal shear forces induced in it by the transverse loading. The calculations which these considerations necessitate can, however, be entirely eliminated by making use of a set of three charts recently published under the title "Charts for the Design of Timber Beams". These charts have been prepared by V. D. Limaye, officer-in-charge of the Timber Testing Station, Forest Research Institute, Dehra Dun, United Provinces. The first of them is designed to ensure that a beam of adequate strength is chosen. In it two nomographs are provided which, from the given load per square foot, span, and spacing, ascertain the total load carried by the beam. Then, by the drawing of four horizontal and vertical lines terminated by suitably placed diagonal lines which are embodied in the chart, the breadth and depth of a sufficiently strong beam are obtained. In most cases in which timber beams are used, it is necessary to restrict the deflection under load to certain specified limits, and stiffness has therefore to be arranged. This is done by means of the second chart, which enables the correct amount of adjustment to be made in the sizes already determined so that the required degree of stiffness is assured, and the process involves only the drawing of another set of horizontal and vertical lines. In the third chart a third series of horizontal and vertical lines leading to a final nomograph either confirms the horizontal shear strength as adequate or shows the correction required so that, in the end, the section evolved is suitable for its purpose from all points of view.

Magneto or Coil Ignition for Motor-Cars

F. R. HAIGH has recently compared the relative advantages of magneto and coil ignition used for generating the explosions which occur in motor-car engines (*Students' Quart. J. Inst. Elec. Eng.*, Dec.). Coil ignition was prominent on the early types of petrol engines, but magnetos appeared on the market and for a number of years prior to 1914 a Bosch magneto was regarded as the acme of perfection. About ten years ago coil ignition systems came to the front. The magneto is of great importance in aero work and is popular on racing-cars, but in motor-vehicles it has been almost entirely replaced by coil ignition. Modern coil ignition systems are

very trustworthy. The causes of the failure of the ignition system are almost always due to battery and wiring faults; they are very rarely due to the ignition apparatus itself. The contact breaker, coil and ignition switch are generally mounted at different points and thus their action is dependent on the soundness of the wiring between them. Loss of magnetism which used to cause trouble with magnetos is absent in coil systems. Ease in starting up an engine is a prominent feature in coil ignition; at whatever speed the engine is turning, a good spark is always obtained at the plug points. The contact breaker is usually the first component to be examined following an ignition failure, and hence its accessibility and ease of adjustment are of great importance. In this respect, coil ignition has nearly always the advantage. A clear view of magneto contact breakers can rarely be attained without the aid of a mirror. Coil ignition is also greatly superior to the magneto so far as the rapid replacement of faulty parts is concerned.

Scandinavian Museums

AN article by J. A. Sidney Stendall on museums in Scandinavia (*Museums J.*, **38**, 397, Nov. 1938) should prove of value to museum curators in Great Britain. The author selects for special description details of exhibition technique. His diagrams of methods of showing specimens, of artificial lighting, and of construction of exhibition cases for straightforward display or for the building up of pictorial dioramas, show how carefully and successfully these aspects have been considered in the museums of Sweden. There are suggestions here the adoption of which would add interest to many museums in Great Britain.

Chromosoma

THE development of the chromosome theory of heredity during the last twenty years has led to the publication of some thousands of papers devoted to a study which is at once genetics and cytology. These papers have been published partly in the special genetical journals—*Genetics*, *Baur's Zeitschrift*, *Genetica*, *Hereditas* and the English and Japanese *Journals of Genetics*—and partly in the special cytological journals—*La Cellule*, *Cytologia* and Messrs. Springer's *Zeitschrift für Zellforschung und mikroscopische Anatomie*. Many also have been published by the older zoological, botanical and general scientific journals. Messrs. Springer have now divided their journal into two parts, which will appear separately this month, marking not inappropriately the centenary of the cell theory. Part A, *Allgemeine Zellforschung und mikroscopische Anatomie* will continue to deal with the physiological and histological side of cell-study with which the old journal was largely concerned. Part B, under the short title of *Chromosoma*, will be in effect a new journal. It will deal with the chromosomes in their twin aspects of cell mechanisms and organs of heredity. Dr. Hans Bauer, of the Kaiser Wilhelm-Institut für Biologie in Berlin-Dahlem, is the general editor. He has secured the collaboration of Dr. Lothar Geitler of Vienna, Dr. T. Caspersson of Stockholm, Dr. A. Müntzing of Lund, Dr. W. v. Möllendorf and Dr. J. Seiler of Zurich, Dr. O. L. Mohr of Oslo, Dr. C. D. Darlington of London, Dr. F. Schrader of New York, and Dr. Th. Dobzhansky of Pasadena. The balance of zoology and botany, chemistry and genetics in this group should ensure a competent discrimination as well as a new point of view in furthering this youngest of the sciences.

Sixth Pacific Science Congress

THE sixth Pacific Science Congress will be held in Berkeley, Stanford and San Francisco, California, during July 24–August 12 under the auspices of the National Research Council of Canada, on the invitation of the U.S. National Research Council. The programme is so constituted as to emphasize the discussion of comprehensive scientific topics of general interest to the peoples living within the Pacific basin, and the theme of the Congress will therefore be "the present stage of knowledge of Pacific scientific problems and methods by which that knowledge may be most profitably enlarged". For this reason, the programme is arranged as a series of symposia rather than a collection of independent papers. Forty-two countries have been invited to take part. Further information can be obtained from Dr. R. E. Clausen, Room 205, Hilgard Hall, University of California, Berkeley, California.

Study Meeting on Magnetism

A STUDY meeting on magnetism, to be held in Strasbourg during May 21–25, is being organized by the Institute of Intellectual Co-operation in collaboration with the Service Central de la recherche scientifique de France. The following subjects will be discussed: (1) paramagnetism, very low temperatures, relaxation and nuclear magnetism; (2) optics and paramagnetism, low temperatures and moderately low temperatures; (3) ordinary paramagnetism; (4) ferromagnetism, (*a*) atomic and molecular moments, (*b*) ferromagnetism and the crystalline network, (*b'*) interaction and its relationship to thermodynamics, (*c*) Curie points, (*d*) gyromagnetic phenomena. A number of papers have already been arranged, and it is expected that about thirty eminent authorities on the subject will attend the meeting. The papers and a report of the discussions will be published in the fifth volume of the "Scientific Collections" of the Institute. Further information can be obtained from the International Institute of Intellectual Co-operation, 2 Rue de Montpensier, Paris, 1er.

Physics in the Textile Industries

THE annual general meeting of the Manchester and District Branch of the Institute of Physics is to be held in the Physics Department of the University of Manchester at 7.30 p.m. on Friday, March 17. Immediately after the conclusion of the business of the meeting, Dr. F. C. Toy, chairman of the Branch, will speak on "The Physicist in the Textile Industries", and will attempt to give some idea of the vast scope in textile research for the employment of theoretical

and applied physics, and for the application of physical methods. In view of the Institute of Physics forthcoming Conference on Textile Physics it may be expected that Dr. Toy's lecture will be of special interest to members of the Institute, and to others connected with the textile industries.

Conference on Industrial Physics

THE third Conference on Industrial Physics is being arranged by the Institute of Physics to take place in Leeds during March 23–25 under the presidency of Prof. R. Whiddington. The subject of the Conference is to be "Physics in the Textile Industries". An exhibition of instruments, apparatus and books cognate to this subject is being arranged and will be held in the Physics Laboratories of the University of Leeds. A section of the Exhibition, intended to be of special interest to non-technical persons, will be devoted to popular applications of physics in the textile industries. Addresses will be given by the president of the Institute of Physics, Dr. C. C. Paterson, on "Colour and Colour Rendering" and by Dr. C. G. Darwin, director of the National Physical Laboratory, on "Heat Effects in Fibres and other Systems". In addition, the following lectures, to be followed by discussions, have been arranged: "The Physics of Humidity" by Prof. R. Whiddington; "Industrial Humidity Control and Measurement" by Dr. Ezer Griffiths; "The Contribution of Physics to the Development of Industrial Process Control" by Dr. M. C. Marsh; and "Automatic Regulators for the Textile Industries" by Mr. D. Harrison. Visits to local works and research laboratories will be included in the programme, and a Conference dinner is being arranged. There will be no Conference fee, and membership is open to all interested. Further particulars can be obtained from the Secretary, Institute of Physics, 1 Lowther Gardens, Exhibition Road, London, S.W.7.

Announcements

THE following awards have recently been made by the Royal Academy of Belgium: Charles Lemaire prize to E. Franchimont; François Deruyts prizes to P. Burniat and F. Rozet; Léo Errera prize to A. Dalcq; Joseph Schepkens prize to R. Steysert; Adolphe Wetrems prize (natural sciences) to C. Stevens; Albert Brachet prize to J. Sven Horstadius. The Paul Fourmarier prize to L. Cayeux. Prof. H. N. Russell, of Princeton, and Prof. A. Pictet, of Geneva, have been elected associates of the section of mathematical and physical sciences of the Academy.

COSTANTINO GORINI has been elected *correspondant* for the Section of Rural Economy of the Paris Academy of Sciences in succession to the late L. Ravaz.

THE following awards have been made by the Council of the Royal Aeronautical Society. *Silver Medal:* Major R. H. Mayo, for his work leading to an advancement in aeronautical design; *Taylor Gold Medal:* Squadron Leader H. P. Fraser, for his paper on "High Wing Loading and Some of Its Problems from the Pilot's Point of View"; *Wakefield Gold Medal:* Mr. Leslie L. Irvin, for his work on parachute design, which has led towards safety in flying; *Busk Memorial Prize:* Squadron Leader G. M. Buxton, for his paper on "The Development of Sailplanes", and to Mr. H. F. Vessey, for his paper on "Effect of Wing Loading on the Design of Modern Aircraft with Particular Regard to Take-off Problems"; *Pilcher Memorial Prize:* Mr. H. E. H. Rochefort, for his paper on "The Theory and Practice of Stressed Skin Construction for Aeroplanes"; *Usborne Memorial Prize:* Mr. P. H. Rayner, for his paper on "Notes on Aero Engine Research".

THE following appointments and promotions in the Colonial Service have recently been made: R. K. Tremlett, agricultural officer, Uganda; J. N. See, veterinary officer, Leeward Islands; W. M. Rogers, tobacco officer, Agricultural Department, Ceylon; O. J. Voelcker, senior botanist, Agricultural Department, Nigeria; N. R. McHardy (senior inspector of plant diseases), land settlement officer, Jamaica.

THE Leipzig Fair will be held on March 5–13. The Samples Fair will be open during March 5–10; but the Great Engineering and Building Fair will be open for the whole time. Further information can be obtained from the London office of the Leipzig Fair, 426–9 First Avenue House, 45 High Holborn, London, W.C.1.

THE Federation of Medical Societies of North Africa will hold its annual congress on April 3–5 at Oran under the presidency of Dr. Jasseron. The subject for discussion will be brucella infections. Further information can be obtained from the general secretary, Dr. René Solal, 16 Boulevard Maréchal Joffre, Oran, Algeria.

THE Royal Statistical Society is offering the Frances Wood Memorial Prize, value £30, for competition in 1939. The Prize is offered for the best investigation, on statistical lines, of any problem affecting the economic or social conditions of the people. Further information can be obtained from the Honorary Secretaries of the Royal Statistical Society, 4 Portugal Street, W.C.2.

WE are asked to state that all reprints of papers of the late Prof. George Barger have been placed in the Department of Chemistry, The University, Glasgow, and copies can be obtained from there on application to the Secretary of that Department.

THE *Proceedings of the Linnean Society*, Part 4, published on December 30, contain, together with the address of the president, Dr. J. Ramsbottom, abstracts of the papers delivered by invitation at the two symposia held by the Society as part of the 150th anniversary celebrations, upon the subjects of "The Concept of Species from the Time of Linnæus to the Present Day" and "Geographical Isolation as a Factor in Species Formation" (NATURE, 141, 998; 1938).

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 381.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Forbidden Lines of Fe VII in the Spectrum of Nova RR Pictoris (1925)

THE bright line spectrum of Nova RR Pictoris (1925) is characterized in the later stages by a group of lines in the visible region, of which the most prominent, λ 5723 and λ 6087, form with Hα and λ 4686 of He II the dominating lines of the spectrum[1]. These lines have not been found in any other spectrum and no adequate explanation of them has been given so far.

Some coincidences between lines in Nova Pictoris and forbidden transitions in Fe VI[2] suggested a search for analogous lines of Fe VII. Extrapolating the position of the multiplet $3d^2\ ^2F - 3d^2\ ^2P$ in Fe VII, one finds a striking coincidence with a group of lines in Nova Pictoris. The significance hereof is strengthened by the exact reappearance of the separation $^2F_2 - {}^2F_3$ between λ 5723 and λ 6087, indicating the identification $^2F_2 - {}^1D_2$ and $^2F_3 - {}^1D_2$. However, due to the uncertainty in the preceding iso-electronic spectra, the location of ^1D could not be predicted by extrapolation, and a previous analysis of FeVII[3] is inconsistent with the suggested identifications. Thus a new attempt at locating the $3d^2$ terms of FeVII became highly desirable. This has now been accomplished, and the result confirms and extends the suggested explanation of the Nova Pictoris spectrum, as will be shown below.

The vacuum spark spectrum of iron photographed with a previously described spectrograph[4] at 0·5 A. per mm., reveals several line groups involving $3d^2$ terms. The group $3d^2 - 3d\,4f$ at λ 150 A. to 159 A., which is well separated from other transitions and shows strong intercombinations, was chosen as the most suitable for the purpose. It was possible to classify *all* (42) observed lines of the group with a tolerance of about 0·001 A. and establish in good agreement with the theoretical formulæ[5] *all* terms of each configuration, which are able to appear in the group. The details of the analysis will be published elsewhere. The $3d^2$ levels thus located are collected in the following table.

$3d^2$	$^3F_2$	0	$3d^2$	$^3P_2$	20037
	$^3F_3$	1047		$^3P_1$	20428
	$^3F_4$	2327		$^3P_0$	21275
	$^1D_2$	17475		$^1G_4$	28916

The calculated wave-lengths (±2A.) of the forbidden transitions between these terms are as follows:

$^3F - {}^1G$	3457·3, 3587·2, 3759·9;
$^3F - {}^3P$	4699·0, 4893·9, 4942·3, 4989·4, 5158·3, 5276·1;
$^3F - {}^1D$	5720·9, 6085·5, 6599·7.

The corresponding lines in Nova Pictoris in 1933, some of which are blends, are 3760·0, 4701·2, 4894·8, 4944·7, 4986·1, 5155·3, 5275·6, 5723·4, 6087·5.

From the comparison it is evident that the complete array of [Fe VII] transitions falling in the investigated region recurs in Nova Pictoris. At the same time, *all* the lines of hitherto unknown origin in the visible spectrum of the late stages of Nova Pictoris are explained.

The following remarks may be added. The strong 'out of focus' line λ 3760, which was previously ascribed to O++, is no doubt mainly due to [Fe VII], although O++ may contribute, especially in the earlier stages of the nova. The nebular pair of [Ca V] is certainly present, one component being λ 5308 and the other coinciding with λ 6087. The blend of [Ca V] and [Fe VII] in λ 6087 would explain the observed variation in the intensity ratio between λ 5723 and λ 6087, which has been considered as indicating that these lines cannot have a common origin[6].

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[1] Jones, H. S., *Mon. Not. Roy. Astro. Soc.*, **94**, 35, 816 (1933-34).
[2] Bowen, I. S., *Phys. Rev.*, **47**, 924 (1935).
[3] Cady, W. M., *Phys. Rev.*, **42**, 322 (1933).
[4] Edlén, B., *Z. Phys.*, **100**, 621 (1936).
[5] Condon, E. U., and Shortley, G. H., "The Theory of Atomic Spectra" (Cambridge Univ. Press, 1935), p. 202 and 206.
[6] See ref. 1, p. 36.

Origin of the Earth's Magnetic Field

THERE is considerable physical evidence that the earth possesses a metallic core[1]. Jeffreys[2] has estimated the viscosity of the core and finds it as low as 10^{10} C.G.S. units. If this value is correct, an intense thermal convection must be maintained in the core by the heat development of radioactive impurities, even if the amount of the latter is exceedingly small compared to their concentration in the earth's crust.

I have developed a tentative theory of the magnetic field based on the assumption that this field is caused by *thermo-electric* currents in the core which owe their existence to the conditions created by the turbulent convection. The thermo-electric current density is

$$I = \sigma \operatorname{grad} \omega - B \operatorname{grad} T, \qquad (1)$$

where σ is the conductivity, ω the potential of the space and surface charges, B the thermo-electric constant of the material and T the temperature. σ, B, T are functions of the co-ordinates. If they are given, ω follows as solution of the differential equation $\operatorname{div} I = 0$ together with proper boundary conditions.

It might appear surprising that the local fluctuations of the currents (1) should sum up to yield a resultant magnetic momentum which is approximately parallel to the earth's axis. The reason for this is found in the action of the *Coriolis force* upon the mechanical motions of the fluid mass. A glance at the hydrodynamic equations will show that for small values of the viscosity the Coriolis force is vastly preponderant as compared to all other dynamical effects. This causes a peculiar east-westerly asymmetry of the temperature variations at a given level. The latter variations are, in the usual way, produced by the vertical component of the convective motions.

For the further considerations, we shall confine ourselves to the second term on the right-hand side of equation (1), which presumably contributes the major part of the magnetic momentum. The discussion of the first term is closely analogous. It is readily seen that the magnetic dipole momentum vanishes, if, for a given depth, B is a constant. This means that in a homogeneous mass no temperature fluctuations would produce a magnetic momentum. In addition to the hypothesis of convective motions, we must therefore admit the existence of *inhomogeneities* in the earth's core. Since any particle of the mass undergoes large pressure changes during vertical displacements, the inhomogeneities are best accounted for by phase transformations induced by the pressure changes which are a frequent occurrence at high pressures[3]. Perhaps there are also considerable chemical inhomogeneities present in the core, and while there would be a regular stratification in a state of rest, the distribution of the phases will become irregular under the constant stirring action of the convection.

No additional assumptions have been found necessary. An attempt has been made to estimate roughly the order of magnitude of the thermo-electric currents. Using some simple results of the theory of metallic conductivity, values of σ and B were estimated for iron under the physical conditions of the core. It was found that with temperature differences so low as 10° the current density is of the order of 10^{-4} amp./cm.^{2}. This is enough to explain the observed magnetic field as the result of a small one-sided excess in a current system of irregular distribution.

A full account of this investigation will appear shortly in the *Physical Review*.

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Jeffreys, H., "The Earth" (2nd ed., 1927, ch. viii).
[2] Jeffreys, *Mon. Not. Roy. Astro. Soc., Geophys.* Suppl., 1, 371, 416 (1926).
[3] Bridgman, P. W., "The Physics of High Pressures" (London, 1931, ch. viii).

The Expanding Universe and the Origin of the Great Nebulæ

SIR JAMES JEANS[1], commenting on our recent letter[2], criticizes the numerical relation between the distances between nebulæ and their radii following from our point of view on the formation of nebulæ. We should like to emphasize here that, owing to the uncertainty of the observational data, the values used by us can only be taken as representing orders of magnitude.

For the diameter of nebulæ we used the value (2,000 light-years) corresponding to spherical nebulæ (*E*0) which seemingly represent the theoretically simplest case. If, however, one uses the most elongated nebulæ the *average* diameter will be larger only by a factor 2·5 not seriously affecting the general agreement.

The numerical discrepancy of a factor $8\pi^2/9 \simeq 9$ between the exact formula of gravitational unstability as developed by Jeans and the simplified one used by ourselves, is due to the fact that Jeans identifies the square of the critical wave-length λ_0, as given in his book, with the square of the *radius* of condensing matter as given by us. This wave-length should be, however, equal to, or larger than, the *diameter* of the condensing sphere; the discrepancy thus becomes less than a factor of two.

The only important modification proposed by Jeans is that instead of Hubble's value $0{\cdot}8 \times 10^{-30}$ gm./cm.^{3} for mean density of matter, he suggests that a larger value $2{\cdot}5 \times 10^{-29}$ gm./cm.^{3} obtained by Sinclair-Smith and others should be used. It should be indicated, however, that whereas Hubble's value for the average mass of nebulæ as used by us was derived from the nebular rotation on the assumption that *the nebulæ themselves are in a state of equilibrium*, the proposed new value is based on the somewhat arbitrary assumption that the so-called clusters of nebulæ are stable. The question as to the status of such clusters is in fact a rather difficult one, and we hope to discuss it in a later publication. Thus it seems more plausible to use Hubble's value which leads to the velocity of particles of the order 100 km./sec. rather than 20 km./sec.

Assuming particles of mass at least equal to that of the hydrogen atom, a temperature of at least $0{\cdot}4 \times 10^6$ degrees C. is obtained. Of course, a pure gas of free electrons could not be responsible for the formation of nebulæ; an equal mixture of free electrons and protons (necessary to secure the neutrality of matter) reduces the temperature only by a factor of two.

A more detailed statement of our point of view and its relation to relativistic cosmology is contained in our longer article soon to be published in the *Physical Review*.

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E. TELLER.

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Feb. 7.

[1] Jeans, Sir James, NATURE, **143**, 158 (1939).
[2] Gamow, G., and Teller, E., NATURE, **143**, 116 (1939). Owing to a manuscript error, a phrase was omitted from this letter. After the word "distances" in the eleventh line from the end, the following phrase should be inserted: "which after correction for reddening becomes an apparent increase in density at great distances".

Crystal Structure of Methane at the Transition Point, 20·4° K.

WE have made a detailed X-ray investigation of the crystal structure of methane in the transition region, and find, in accordance with previous results[1], that the lattice of methane above and below the transition point is a face centred cube.

In the neighbourhood of the transition point, new lines appear on the photographs apart from those belonging to the face centred cube. We observed as many as five. Some of these lines are quite strong and comparable in intensity with those of the normal lattice. Mooy (*loc. cit.*) has already found evidence of additional lines which he calls parasitic lines.

We have come to the conclusion that these new lines, including the 'parasitic' ones, are essentially connected with the transition and cannot therefore be treated as if they were merely accidental.

A detailed account of this work is to be published shortly.

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Feb. 14.

[1] Mooy, H. H., *Comm. Leiden*, 213 *d*.

Spectrum of Singly Ionized Tellurium (TeII)

AN extensive investigation of the spectrum of tellurium as excited especially in condensed discharges through capillary tubes and in vacuum sparks and photographed in the region from λ 7000 A. to λ 400 A. has led me to an elucidation of the analysis of the higher spark spectra of the element[1]. A further study of the above data has now revealed the structure of the spectrum of singly ionized tellurium (TeII). The lines νν 86,096, 82,742, 78,447 are identified as forming the fundamental combination $5p^4S - 6S^4P$ which has enabled the extension of the scheme into the region of longer wave-lengths. It has been possible to set up a related system of doublet and quartet terms through the detection of several intercombination lines. The $5p^2D$ and ^2P intervals are found to be 2,734 cm.$^{-1}$ and 4,180 cm.$^{-1}$ respectively. The structure is analogous to that of SeII worked out by me previously[2].

Full details of the analysis are being prepared shortly.

K. R. RAO.
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Feb. 3.

[1] *Proc. Roy. Soc.*, A, 133, 220 (1930); 158, 562 (1937).
[2] *Proc. Roy. Soc.*, A, 149, 56 (1935).

Achromatic Lenses employing Lithium Fluoride and Fused Quartz

THE introduction of lithium fluoride in synthetic crystal form (a technique developed by Dr. D. C. Stockbarger[1] and his colleagues at Massachusetts Institute of Technology) has been the means of filling a much-needed want in optical materials. In Great Britain little use appears to have been made of this material. Its chief characteristic is its high transparency from wave-length 1200 A. up to 20,000 A.; furthermore, its homogeneity is excellent (even in large crystals) and in this respect is superior to fluorite or quartz.

I made use of this material some two years ago when a vacuum spectrograph[2] was constructed employing lithium fluoride for the optical components. No deterioration of the surfaces of the prism or lenses of this instrument has been detected during this period.

More recently, I have completed calculations for the design of a lens system (combining lithium fluoride and fused quartz), which gives complete achromatism for a spectral range between λ 5461 A. and λ 2749 A. This fact would appear to be of considerable importance, for it means that a lens system designed for use in the ultra-violet part of the spectrum can be focused in visual light, and no change in focus will be necessary for the ultra-violet. Moreover, a band of ultra-violet wave-lengths may be employed with such a lens system instead of strictly monochromatic illumination, as has hitherto been necessary in the case of ultra-violet microscope lenses.

Lithium fluoride combined with fused quartz achromatic lenses might also be of value for the collimator and telescope lenses of spectrometers used in the ultra-violet region, spectrographs, and possibly photographic lenses.

The suitability of these two materials for achromatizing purposes is clearly indicated in the calculations. The spherical aberration and the offence against the sine condition can also be kept within the permissible tolerances.

The microscope lens system which has been designed is now under construction and the results will be published in due course.

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Technical Optics Department,
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London, S.W.7. Jan. 31.

[1] Stockbarger, D. C., *J. Opt. Soc. America*, 15, 359 (1937).
[2] Johnson, B. K., *J. Sci. Instruments*, 15, 126 (1938).

Meteoric Falls in the U.S.S.R.

Meteorite at Kukschin, Nezhin, Tschernigow, Ukraine. This meteorite fell on June 11, 1938, at about 11^h U.T. (2^h p.m.). The place of the fall is 0·9 km. east of the village of Kukschin, Nezhin district, Tschernigow region (lat. 57° 03′ N., long. 31° 50′ E.), 25 km. north-west of the town Nezhin. The sky was quite cloudless; but no conspicuous optical phenomena were witnessed. Acoustic phenomena, resembling the roar of distant thunder or gunfire, were heard over an area of 12 km. radius. Their duration was on the average 8 sec. Three shepherds, G. Pivovar, I. Miroshnikov and I. Mosko, heard, moreover, a noise and whistle and had a glimpse of a grey or bluish body cutting itself into the ground a few metres from them; a cow fell to the earth at a distance of 4·5 m. About one hour later they took the meteorite out of the pit, 30 cm. deep, it had formed. Its top was 2 cm. below ground. The soil is here dried up owing to drought, but is normally swampy and covered with grass. The fallen meteorite, weighing 2,250 gm., of irregular shape, with smoothed angular contours, scattered the earth 5 cm. from the edges of the pit, mostly in the eastern direction.

The Geological Institute of the Ukraine Academy of Sciences, Kiev, was informed of the fall, and on June 29, Souchtchitzky, a scientific worker of the Institute, took the meteorite to Kiev. At the Institute, Pilipenko, analytical chemist, obtained the following results by analysis of the meteorite.

Composition		I Per cent	II Relative Numbers	III Relative Numbers	IV Per cent
SiO_2	..	44·40	12·48	39·80	39·96
FeO	..	40·04	86·86	46·79	46·23
Al_2O_3	..	2·21	0·23	0·52	1·75
MnO	..	0·003	0·04	0·02	0·053
Cr_2O_3	..	0·54	0·19	0·29	0·45
MgO	..	7·89	—	—	6·22
CaO	..	2·51	—	—	1·91
S	..	2·88	1·23	2·47	2·77
NiO	..	traces	13·60	3·20	1·85
TiO_2	..	,,	0·12	0·05	0·018

The crust was taken off during the analysis (III, totalling 1·75 gm.). The inner substance of the

meteorite was pounded in a mortar and the magnetic portion was isolated (II, total 2·46 gm.), as was the non-magnetic portion (I, 1,573 gm.). Column IV of the table shows the mean chemical composition of the meteorite as given by the director of the First Astronomical Observatory of Odessa, R. L. Dreizin, who inspected the place of the fall on August 26–31, 1938. I wish to express my gratitude for information provided by him.

The meteorite has small hollows or piezoglypts. It is covered with a dull black crust; inside it is grey. The shepherds had broken off a small piece, which is lost, from one of the angles. Its shape is not orientated.

The direction of flight was approximately from south-west to north-east; the geocentric velocity was evidently very small (absence of light phenomena, loud detonations, crushing and deep piezoglypts). The meteorite obviously fell as one stone. The position of the radiant, a = S. 30° W., h = 30° for $14^h\ 07^m$ local time gives the equatorial co-ordinates $\alpha = 88°$, $\delta = 2°$, that is, 23° from the sun ($\alpha = 79°$, $\delta = 23°$). The apparent elongation from the apex is $\varepsilon = 99°$, the true elongation for a parabola is $\varepsilon' = 143°$, and the unperturbed geocentric velocity $v'_g = 10{\cdot}8$ ($v'_g = 15{\cdot}6$ km./sec.), which accounts for the weakness of the acoustic and optical phenomena.

The "Zhovtnevyj" Meteorite, khutor Pavlovka, Mariinsky District, Stalino region, Ukraine. This stone meteorite fell on October 10, 1938, entering to a depth of 70 cm. into the ground. Its weight is 30 kgm. The fall occurred at night. Some days later it was found by a peasant, Maria Boushna. The meteorite was dragged out of the hole it made and broken into many fragments. At the break it is grey, stony, with metallic spangles. The greatest part of the fragments was taken to the Stalin Museum (at Stalino, Ukraine), four pieces were brought to the Academy of Sciences of the U.S.S.R., Moscow, to the Meteorite Commission. On December 16 another large piece was handed over to the Academy.

This meteorite is the fifth to be found in 1938 in the U.S.S.R. The total number of meteorites of the U.S.S.R.[1] is now (Jan. 1, 1939) ninety-five.

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Jan. 6.

[1] Astapowitsch, I. S., *J. Roy. Ast. Soc. Canada*, **32**, No. 7, 195–196, 1938 (A list of the meteorites of the Soviet Union).

The Helm Wind of Crossfell

OCCURRENCES of 'helm wind' have been tantalizingly few; several have coincided with other engagements, or with serious difficulty in crossing the Pennines. It is established, however, that (*a*) the characteristic phenomena[1] are liable to occur whenever a well-developed current of air is flowing from a direction between east and north-north-east, that is, within about 30° of a direction at right angles to the trend of the escarpment. With deviations greater than this, considerable modifications are found to occur. (*b*) The depth of the surface air current up to the summit level of the clouds should be not greater than about 5,500 ft. The observed phenomena then appear to be analogous to those at a submerged weir with faces inclined gently upstream, and more steeply downstream. The 'helm wind' corresponds to the 'rapid' set up in the air-current flowing over the escarpment; the crest of the downstream 'standing wave' is marked by the 'helm bar'. If the north-easterly current is of greater uninterrupted depth, the 'standing wave' appears to flatten out and the 'bar', with its underlying reverse current at ground-level, is no longer found.

Keen local observers therefore distinguish 'general north-east wind' from 'helm wind', and from the evening 'fell wind', a katabatic flow in quiet weather. As might be expected, the wind at the ground is characteristically very gusty near a point halfway between the 'helm cloud' and the 'bar', sometimes causing structural damage. The desiccating effect in spring near the escarpment may also be serious. With wind of force 6 at Tynemouth, the 'helm wind' may be expected to attain force 9 on open slopes; progress against it is not easy.

It is hoped that a reasonable explanation will soon be given of numerous local sayings and writings based on observation; the continuous record of temperature at 2,735 ft. should also be of interest.

These investigations have been carried out during the past year with the help of a grant from the Leverhulme Trustees.

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Feb. 13.

[1] Meteorological Glossary, p. 101; Marriott, *Quart. J. Roy. Met. Soc.*, **15** (1889).

Micro Separations by Chromatographic Adsorption on Blotting Paper

THE separation of mixtures on a micro scale by chromatographic adsorption was carried out as long ago as 1910 by Tswett, the discoverer of the process, and by various others since, but the method has not been applied as extensively as its extraordinary power would warrant. The preparation of the adsorbent column and the development of the chromatogram are troublesome and time-consuming operations and the process ordinarily comes under consideration only as a last resort. The purpose of this communication is to describe a simple and rapid method of effecting such separations which avoids entirely the difficulties inherent in the use of Tswett columns, and which, in addition, possess distinct advantages of its own.

The technique consists essentially in the use of ordinary white blotting paper, or a suitable grade of filter paper, as the adsorbent medium. A sheet of the paper is placed between two pieces of plate glass (6 in. × 6 in. is a convenient size) one of which, the cover plate, has a small hole (3/16 in. or 1/4 in.) at its centre. A solution of the material under investigation is introduced through this hole, either dropwise or by means of a pipette with a capillary tip resting on the paper, and this is followed by the introduction of the developing solvent. Under these conditions, the components of the solution travel outward in concentric zones. The chromatogram is then obtained in a form which is particularly well suited to visual examination if coloured substances are present, or to examination by appropriate chemical or physical methods in the case of colourless substances. In addition, this type of chromatogram possesses the distinctive feature that it may be filed, after drying, for future reference. The paper being readily available, no extensive preliminary preparations are

necessary and the time required for an experiment is from three to five minutes.

The adsorbent characteristics of papers differ somewhat, but the choice of paper for this work will be governed rather more by other factors such as porosity, uniformity, and freedom from impurities. A thin and moderately hard blotting paper is more satisfactory in physical characteristics than filter paper of ordinary thickness, but it should be pointed out that many commercial white blotting papers contain a blue colouring matter which may give rise to spurious zones under certain conditions. The blotting paper made by the Eastman Kodak Co. for photographic purposes is fairly satisfactory in this respect.

It has been found that a surprising number of separations of various kinds can be carried out on paper, for although paper is not a particularly powerful adsorbent, what it lacks in this respect can very often be compensated by a suitable choice of solvents. There are, nevertheless, numerous problems in analysis by chromatographic adsorbtion which necessitate the use of a more powerful adsorbent. In order to retain the simplicity and convenience of the present method it would be desirable to secure for this purpose an absorbent paper impregnated with suitable adsorbing materials, particularly alumina. At the present time one may adopt the expedient of using a film of the powdered adsorbent between two sheets of filter paper.

As a lecture demonstration experiment the separation of the pigments of green leaves can be recommended. It is carried out most effectively on paper using a carbon disulphide solution of the pigments and using carbon disulphide also as the developing solvent. The brilliant colours of the carotenoid pigments together with the two chlorophyll pigments present a very striking display when resolved in this way.

The new method is not proposed as a substitute for the Tswett column when quantities of more than a few milligrams are to be treated. It is strictly a micro method, and as with the micro Tswett column the difficult problem of identifying the zones is constantly arising. However, it can be recommended as a useful adjunct to the Tswett column, as the task of finding by trial the most favourable conditions for a particular separation is greatly simplified. Attention is directed to the possibility of adapting the method to various problems in quantitative analysis, particularly where coloured substances are dealt with, and also to the possibility of its use, in conjunction with organic reagents, in qualitative inorganic analysis.

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Nov. 25.

Lipæmia and Calcæmia in the Cock induced by Diethylstilbœstrol

RATS as well as chickens are transformed into eunuchoid dwarfs by prolonged treatment with œstrogenic hormone[1]. During these experiments, a high degree of lipæmia was found in the chickens[2]. The total blood fat can rise to 8,000 mgm. per cent (the normal being 100–200 mgm. per cent). The animals, the blood of which looks like cream, can finally succumb with dyspnœic symptoms to fat thrombosis of the pulmonary blood vessels, in extreme cases. The internal organs, too, show considerable lipæmia. Thus, for example, the fat content of the liver can rise to 24 per cent of the dry matter (normal being 4·56 per cent). Lipæmia is found physiologically in the hen during the egg-laying season (increase from 100 mgm. to 580 mgm. per cent). In the cock, no spontaneous lipæmia occurs. Œstrogenic hormone, however, can induce lipæmia in the cock as well, dependent on the dose of hormone administered. Œstradiolbenzoate proved to be two and a half times as effective as œstrone. One dose of one mgm. œstradiolbenzoate is ineffective; two days' treatment, however, with 2 mgm. daily, certainly results in lipæmia on the third day (increase to 600–800 mgm. per cent). This lipæmia due to œstrogenic hormone is independent of nutrition, occurring likewise in fasting animals. In rodents (rabbits, rats), as well as in man, even prolonged administration of large doses of hormone does not induce lipæmia. This lipæmia represents the specific effect of œstrogenic hormone, since no effect is obtained either with cholesterol or with sterol-like hormones (we tested progesterone and testosterone).

During recent years, a number of synthetic substances having an œstrogenic effect have been discovered, the most active of which is the 4 : 4'-dihydroxy-α-β-diethylstilbene (diethylstilbœstrol), which was described by Dodds, Golberg, Lawson and Robinson in 1938[3]. This substance is able to initiate œstrus in ovariectomized rats, given in doses of 0·3–0·4 γ. Comparative tests show it to be between two and three times as potent as œstrone under similar conditions. After having ascertained that the production of lipæmia in the cock was due to the specific action of œstrogenic hormone, it was obvious that the question of whether this synthetic substance, which differs chemically from the œstrogenic hormone, was able to exert similar effects to those of the hormone, should be investigated.

0·5 mgm. of diethylstilbœstrol does not increase the blood fat, while 1 mgm. gives rise to an increase of 122–517 mgm. per cent. Two days' treatment with 4 mgm. respectively results in enormous lipæmia on the third day, the fat proportion increasing from 196 to 2,380 mgm. per cent. After six days' treatment with 24 mgm. of diethylstilbœstrol it increases from 125 to 5,430 mgm. per cent (cf. accompanying table).

LIPÆMIA AND CALCÆMIA IN THE COCK INDUCED BY DIETHYLSTILBŒSTROL.

Date	Diethylstilbœstrol mgm.	Blood fat mgm. per cent	Blood calcium mgm. per cent	Remarks
Nov. 28	Before treatment	125	11·2	
Nov. 28	4			
Nov. 29	4			
Nov. 30	4			
Dec. 1		3280	30	After 12 mgm. of diethylstilbœstrol
Dec. 1	4			
Dec. 2	4			
Dec. 3	4			
Dec. 4		5438	41·4	After 24 mgm. of diethylstilbœstrol

Calcæmia. The striking changes of the bone structure[1] encountered in eunuchoid dwarf cocks lead to the conclusion that prolonged administration of œstrogenic hormone produces changes of the calcium metabolism. In fact, enormous calcæmia was found in those dwarf cocks[2]. The calcium concentration in the blood of the cock is normally up

to 15 mgm. per cent, while it rises in the hen during the egg-laying season to as much as 26 mgm. per cent. In those cocks which had been treated with œstradiolbenzoate for a considerable period of time we encountered calcium values of so much as 55·3 mgm. per cent on an average. Lipæmia and calcæmia follow parallel lines. Riddle and Dotti[4] succeeded in producing calcæmia in animals through administration of œstrogenic hormone, the values increasing from 10 to 12–14 mgm. per cent. Such an enormous calcæmia as we succeeded in producing through administration of large doses of œstrogenic hormone has not yet been observed so far as we know.

The action of diethylstilbœstrol is similar to that of œstradiolbenzoate. After 2 days' administration of 4 mgm. of diethylstilbœstrol respectively, the blood calcium, in the cock, rises to 22·6 mgm. per cent. Subsequent to 6 days' treatment with 24 mgm. it is 41·4 mgm. per cent (cf. accompanying table).

The strong action of diethylstilbœstrol also results from the fact that only two weeks after the first injection the cock's comb begins to shrivel and becomes anæmic, while prolonged treatment produces loss of turgor and makes it drop.

The above investigations, therefore, demonstrate that diethylstilbœstrol, like œstrogenic hormone, brings about lipæmia and calcæmia in the cock, while being at least as effective as œstradiolbenzoate.

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[1] Zondek, B., *Lancet*, 10 and 842 (1936); *Folia Clinica Orientalis*, 1, 1 (1937).
[2] Zondek, B., and Marx, L., *Arch. Internat. Pharmaco-dynamie and Thérapie* (1939) (in the Press).
[3] Dodds, E. C., Golberg, L., Lawson, W., and Robinson, R., NATURE, 141, 247 (1938).
[4] Riddle, O., and Dotti, L. B., *Science*, **84**, 557 (1936).

Pituitrin Anæmia

Dodds and Noble[1] first described the severe anæmia occurring in rabbits following parenteral administration of posterior pituitary extract. They considered this action of pituitrin a selective one on the cellular elements of the blood. We[2] confirmed the anæmia caused by pituitary extract, but placed a different interpretation on the mechanism involved, for accompanying the anæmia there was a marked fall in the osmotic pressure of the blood. We therefore believed that the dilution in the concentration of extracellular electrolytes resulted in a passage of fluid into the red cell with a subsequent rupture of the cell membrane. The reduced electrolyte concentration of the serum was considered to be the result of the powerful antidiuretic action of large doses of pituitrin. Also, the possibility that pituitary extract may promote the excretion of large amounts of electrolyte was considered.

Dodds, Liu and Noble[3] take exception to the above interpretation on the basis of their studies of the water balance of rabbits following pituitrin injection. They observed that, although an oliguria resulted, the water intake of the injected animals also decreased. Therefore, it was concluded that rabbits were not in a positive water balance, and hæmolysis could not have resulted from water retention.

The issue resolves itself into the relative value of an accurate determination of serum osmotic pressure versus an approximation of the water balance of a rabbit for determining the electrolyte environment of the red cell. The term approximation is used because the rabbit is a notoriously difficult species in which to determine water balance. The gastro-intestinal tract of these animals is always filled with a semifluid chyme. Even if the inhibition of urinary secretion is exactly balanced by the diminished water intake, appreciable dilution of the serum occurs as absorption of fluid proceeds from the gastro-intestinal tract. Also it must not be overlooked that pituitrin causes the excretion of electrolyte as well as the retention of water. These two factors can combine to alter the osmotic pressure of the serum and cause extreme swelling of the blood corpuscles. It is our belief, however, that water retention is the primary cause for the alterations in blood chemistry.

In the experiments of Dodds and collaborators, blood volume determined by a method not mentioned failed to show any increase. We, on the other hand, measured serum osmotic pressure by the vapour pressure method of Hill[4], one of the most sensitive of analytical procedures. We found the serum of the injected rabbits to be isosmolar with sodium chloride solutions of 0·64 per cent instead of 0·9 per cent which is normal. In one experiment the diminution in the concentration of serum electrolyte was so great that the serum was isosmolar with a 0·56 per cent sodium chloride solution. Dodds and co-workers, however, criticize these figures by an indirect approach which does not take into account the possibility of an internal water shift. We made note of the fact that the food intake and consequently the fluid ingestion of their experimental rabbits were markedly diminished. Nevertheless the reported changes in the serum electrolyte concentration did occur. Until it can be shown that severe pituitrin anæmia can be obtained in the absence of any change in the electrolyte composition of the fluid medium of the red blood cell, we believe that the cause of this anæmia is erythrocyte hæmolysis resulting from water shifts and not the "agglutinating and hæmolyzing" property of posterior pituitary extract on red blood corpuscles.

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Jan. 12.

[1] Dodds, E. C., and Noble, R. L., NATURE, **135**, 788 (1935).
[2] Gilman, A., and Goodman, L., *Amer. J. Physiol.*, **118**, 241 (1937).
[3] Dodds, E. C., Liu, S. H., and Noble, R. L., *J. Physiol.*, **94**, 124 (1938).
[4] Hill, A. V., *Proc. Roy. Soc.*, A, **127**, 9 (1930).

Phytic Acid and Mineral Metabolism in Poultry

THE possible parts played by phytic acid in the mineral metabolism of poultry have received surprisingly little study. Recently Lowe, Steenbock and Krieger[1] have directed attention to the significance of this subject, and have shown that, with diets where addition of phytin failed to improve calcification, the addition of the same amount of phosphorus as disodium hydrogen phosphate improved calcification.

A series of mineral metabolism experiments with pullets in progress in this laboratory lends strong

support to these observations. It has been found that pullets fail to hydrolyse a considerable proportion of the phytic acid present in their rations. Calcium carbonate supplements appear to lower the proportion hydrolysed, just as in the case of the rat[2]. The experiments also suggest that when a ration is supplemented with calcium (*a*) in the form of carbonate and (*b*) in the form of tribasic calcium phosphate, a greater proportion of the phytic acid is hydrolysed in the case of the ration supplemented with calcium phosphate than in the case where the supplement is calcium carbonate.

It is also clear from the experimental results secured to date that the conclusions of Knowles, Watkin and Hendry[3] with regard to the nature of the calcium and phosphorus compounds present in the excreta of the domestic fowl require modification, in so far as a considerable proportion of the phosphorus excreted by pullets on rations similar to those used by these workers is in the form of phytic acid phosphorus. Furthermore, while the rule found by Knowles, Watkin and Hendry[3] with regard to the ratio of 'non-carbonate calcium' to total phosphorus in the excreta has been verified in the case of non-laying pullets, it does not appear to hold for the excreta of laying pullets, even when the excreta contain appreciable amounts of carbonate.

It is hoped to publish a fuller account of these experiments at a later date.

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Jan. 26.

[1] Lowe, J. T., Steenbock, H., and Krieger, C. H., *Poultry Sci.*, **18**, 40 (1939).
[2] Lowe, J. T., and Steenbock, H., *Biochem. J.*, **30**, 1991 (1936).
[3] Knowles, F., Watkin, J. E., and Hendry, F. W. F., *J. Agric. Sci.*, **23**, 197 (1933).

A Metabolic Explanation for Irritation and Coma Produced by Rise in Intracranial Pressure

INCREASE in pressure inside the cranial cavity, whether local or general, first produces symptoms of cerebral irritation such as convulsions, contraction of the pupil, vomiting and rise of blood pressure, and is followed by coma, dilatation of the pupil, and other symptoms of paralysis of the nerve centres. The current explanation for this train of symptoms, which is seen in many pathological processes (for example, intracranial hæmorrhage, œdema, tumour, etc.), supposes that irritation is caused by congestion of the cerebral vessels and cyanosis, while further increase in pressure produces profound cerebral anæmia and coma.

The first result of a rise in intracranial pressure is to cause partial collapse of the venous sinuses of the dura mater and of the cerebral veins[1], accompanied by a diminution in the rate of venous return. Accordingly the rate of oxygen supply to the brain is much diminished and approximately anærobic conditions are realized in some of the cells. Now, it has been shown that under anærobic conditions the rate of katabolism of glucose by cerebral cortex is enormously increased[2]. Thus the rate of catabolism of glucose by rabbit's cortex has a low value in oxygen ($Q_{c_6} = -3$), whereas in nitrogen this quotient is increased manyfold ($Q_{c_6} = -8$). Recent observations which I have made on the metabolism of human cortex (kindly given to me by Mr. McConnell of the Richmond Hospital, Dublin) indicate that here anoxæmia has essentially the same effect in increasing metabolism. Thus the Q_{c_6} of human cortex, calculated from measurements of respiration and glycolysis, is -3 in oxygen and -10 in nitrogen. This stimulation of metabolism may well be accompanied by stimulation of the nerve centres, and thus convulsions and other symptoms of irritation are really due to the intracerebral anoxæmia, which is itself the result of rise in intracranial pressure. Still further increase in intracranial pressure causes capillary collapse and so seriously impedes the cerebral circulation as to deprive the brain cells of glucose, their main metabolic substrate. The rate of cerebral metabolism is now substantially diminished even below its normal level, and irritation thus gives place to paralysis. In this manner, a progressive rise in pressure within the cranial cavity may first produce a stimulation of metabolism associated with irritation, and is later followed by diminution or even cessation of metabolism, accompanied by coma and other terminal symptoms of compression.

The convulsions produced by heart block in man and by ligation of the carotids and vertebrals[3] in animals have probably the same cause as those produced by rise in intracranial pressure. In these cases also, anoxæmia causes increase in katabolism of sugar by the brain cells with increase in nervous irritability. Further, Loewenhart, Lorenz and Waters[4] have found that intravenous injection of sodium cyanide causes stimulation of the respiratory centre and also a remarkable cortical stimulation in stuporous cases of dementia præcox. They suggest that the cyanide, by inhibiting oxygen absorption, stimulates anærobic metabolism. Stone[5] also has shown the lactic acid content of brain increased by cyanide convulsions and suggests that convulsions may be associated with increased tissue activity. I have found the Q_{c_6} of rabbit's cortex, as above calculated, to be increased from -2 to -7 by the addition of 2×10^{-3} *M.* sodium cyanide. The respiration is simultaneously diminished by 50 per cent, but the ærobic lactic acid production is markedly stimulated. Here again increased nervous activity is connected with increase in katabolism of glucose.

K. C. DIXON.

King's College,
Cambridge. Feb. 2.

[1] Cushing, *Amer. J. Med. Sci.*, **124**, 375 (1902).
[2] Dixon, *Biochem. J.*, **30**, 1479 (1936).
[3] Gildea and Cobb, *Arch. Neurol. Psych.*, **23**, 876 (1930).
[4] Loewenhart, Lorenz, and Waters, *J. Amer. Med. Ass.*, **92**, 880 (1929).
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Proteins of Rattlesnake Venom

RECENTLY, Slotta and Fraenkel-Conrat [1,2] reported that they have succeeded in separating the whole of the neurotoxin and hæmolysin of *Crotalus-t-terrificus* venom in a crystalline form, and that repeated recrystallization of this substance did not change its physiological properties or its chemical composition. This crystalline substance containing both neurotoxic and hæmolytic activities was considered by them to be a pure substance. In the course of our investigation on the separation of the various active principles of *Crotalus-t-terrificus* venom, we have found that the hæmolysin can be partially separated from the neurotoxin by adopting the following procedure :

100 mgm. of venom was dissolved in 10 c.c. water

and its *p*H adjusted between 7·0 and 7·2. The solution was then saturated with sodium chloride and left overnight inside a refrigerator at 6° C. The next morning the precipitate formed was separated by centrifuging and washed once with saturated sodium chloride. This precipitate was found to contain 8–10 per cent of the total hæmolytic activity and only 2–2·5 per cent of the total neurotoxic activity of the original venom. Thus the percentage ratio of hæmolysin to neurotoxin has a much higher value, 4 : 1, in the precipitate we obtained, than it had in the original venom. It is evident, therefore, that the hæmolytic and neurotoxic activities of *Crotalus-t-terrificus* venom are due to two different substances. Hence the crystalline substance which Slotta and Fraenkel-Conrat obtained was not a pure protein, but a mixture of at least two different proteins. In this connexion, it may be mentioned that we have succeeded in separating the hæmolysin completely from the neurotoxin of *Naja Naja* venom as reported elsewhere[3].

We wish to thank the Indian Research Fund Association for a grant for continuing this work.

B. N. GHOSH.
S. S. DE.
University College of Science and Technology,
Calcutta. Jan. 18.

[1] Slotta, K. H., and Fraenkel-Conrat, H., NATURE, 142, 213 (1938).
[2] Slotta, K. H., and Fraenkel-Conrat, H., *Ber. deutsch. chem. Ges.*, 11, 1623 (1938).
[3] Ghosh, B. N., and De, S. S., *Science and Culture*, 585 (May 1937).

The Prehensile Paw of the Giant Panda

THERE is little to be said in answer to Prof. Wood Jones's remarks on this subject[1]; but I can assure him I overlooked neither of the facts he thinks I did. I gave him the credit for the interesting discovery, previously only an inference from what was known of the skeleton of the foot, that the sesamoid bone in question has a special muscular arrangement whereby it can be moved.

Possibly I should feel gratified by his confirmation of my statement that the grasping method of the panda's fore paw is strictly comparable to that effected by closing the tips of the first and second fingers on the ball of the thumb in the human hand. It is unfortunate that in his first account he conveyed the idea that the method is equivalent to that exercised by the entire thumb. Without reservation and without fear of admonition from anyone acquainted with the undissected paw of this animal, I adhere to my assertion that his description was misleading; and I venture to predict that wisdom will forbid its repetition in his final treatise on the subject.

R. I. POCOCK.
British Museum (Natural History),
Cromwell Road,
London, S.W.7.
Feb. 20.

[1] NATURE, 143, 246 (1939).

Points from Foregoing Letters

HAVING obtained the vacuum spark spectrum of iron, Dr. I. S. Bowen and Dr. B. Edlén have determined the wave-lengths of the forbidden transitions between the terms of the $3d^3$ levels, and find that these lines correspond to the lines of hitherto unknown origin in the spectrum of Nova RR Pictoris (1925).

Assuming the existence of inhomogeneities and thermal currents in the earth's core, Dr. W. M. Elsasser calculates that temperature differences so low as 10° would give rise to currents whose irregular distribution may result in a small one-sided excess that would account for the earth's magnetic field.

Dr. G. Gamow and Dr. E. Teller, in reply to Sir James Jeans's criticism of their hypothesis of the origin of nebulæ, point out that most of the objections raised would not affect the order of magnitude of their calculated result. An important difference in the value for the mean density of matter arises, however, if one accepts Sir James's assumption that the so-called clusters of nebulæ are stable, rather than that the nebulæ themselves are in a state of equilibrium, as supposed by the authors.

The usefulness of synthetic lithium fluoride crystals as optical material owing to its transparency to wave-lengths from 1200 A. up to 20,000 A., is stressed by B. K. Johnson, who states that he has designed a lens system combining lithium fluoride and fused quartz, which should give complete achromatism for a spectral range between 5461 A. and 2749 A.

A simple method for the micro-separation of the components in a mixture by capillary adsorption on filter paper is described by Prof. W. G. Brown.

Diethylstilbœstrol, like œstradiolbenzoate and œstrone, increases the fat and calcium concentration in the blood of the cock, and eventually causes the loss of the comb, according to Prof. B. Zondek and L. Marx.

Prof. A. Gilman and Prof. L. Goodman claim that their explanation of the anæmia produced in rabbits by administration of posterior pituitary extract, being due to the fall in the osmotic pressure of the blood, are more likely to be correct than the results obtained by Dodds and collaborators based upon the "water balance" of rabbits.

Experiments reported by Dr. R. H. Common indicate that when phytin alone is added to the diet of pullets they fail to utilize it completely. Calcium phosphate, if added, increases the proportion of phytin hydrolysed to a greater extent than does calcium carbonate.

In the absence of oxygen, the katabolism of carbohydrate by both rabbit and human cerebral cortex is increased. Dr. K. C. Dixon suggests that the convulsions and cerebral irritation which follow rise in intracranial pressure and other processes producing cerebral anæmia, are due to this increased metabolism of the brain cells associated with stimulation of the nerve centres.

Dr. B. N. Ghosh and S. S. De describe a method for the partial separation of the hæmolysin in the venom of *Crotalus-t-terrificus* from the accompanying neurotoxin and point out that the crystalline substance prepared by Slotta and Fraenkel-Conrat, possessing both those properties, is probably a mixture.

Research Items

Anthropometry of the Ovimbundu, Angola

IN the course of the Frederick H. Rawson Field Museum Ethnological Expedition to West Africa, measurements were obtained of 53 adult male Ovimbundu, which, though an inadequate sample, are valuable owing to the paucity of material from Angola. There are, it is believed, no other measurements of the Ovimbundu available for comparison. This material has been studied by W. D. Hambly, of the Field Museum of Natural History, Chicago (*Publication* 426, *Anthropological Series*, 25, 2; 1938). In skin colour all were brown, and only four approached black, which four might be described as 'light brown'. All eyes were dark brown, and the hair was typically Negro. Facial hair was sparse. The standing height averaged 1687·1 mm., just within the tall class. The average length of the head is 187·3 mm. and the breadth 136·8 mm., with an average cephalic index of 73·1. The average head height is 135 mm. The cranial capacity (Pearson's formula) is 1370 c.c. The facial index is 93·7 and the average nasal index 87·9, just within the platyrrhine group. Measurements on the nose show high variability, 35·8 per cent being mesorrhine, 58·5 per cent platyrrhine. Only 5 per cent are hyperplatyrrhine, with an index of 100+. In regard to variation, head-breadth stands first in constancy of measurement, while head-length is almost as constant. The cephalic index also has a low variability. In comparison with other tribes of Angola, the Ovimbundu are not greatly removed in stature from the men of eastern Angola; but they are decidedly more long-headed and mesorrhine. The differences may be due to fixation of type owing to isolation. The Ovimbundu are known to have built up a strong confederacy. Compared with negro tribes outside Angola, the general build and physiognomy, together with the nasal index, suggest a contact, perhaps remote in time, with the north-east African element described as Hamitic.

Cyanide in the Determination of Ascorbic Acid

M. Cushman and A. M. Butler (*Proc. Soc. Exp. Biol. and Med.*, 39, 534; 1938) review the literature and present further evidence concerning the effect of potassium cyanide on 2-6-dichlorophenolindophenol, the stability of ascorbic acid in whole blood, plasma and plasma filtrate, and the question whether potassium cyanide should or should not be used with plasma ascorbic acid determinations. Their conclusions were as follows: The use of potassium cyanide does not necessarily invalidate the results and may cause no error. Certain lots of potassium cyanide may decolorize 2-6-dichlorophenolindophenol, the decolorizing power of a particular lot depending upon the concentration of the salt and the *p*H of the dye-salt solution. Reduced ascorbic acid is stable in whole blood or metaphosphoric acid filtrates for so long as 24 hours. There is a significant loss of reduced ascorbic acid when plasma stands at room temperature for more than four hours. The loss is not prevented by the presence of potassium cyanide. There is therefore no reason for the addition of potassium cyanide in the determination of plasma ascorbic acid.

*p*H Stability of Elementary Bodies of Vaccinia

J. W. Beard, H. Finkelstein and R. W. G. Wyckoff (*J. Immunol.*, 35, 415; 1938) determined the *p*H range of infectiousness of purified suspensions of the elementary bodies of vaccinia in rabbits by titration. The infectiousness was found to be most stable between *p*H 4·5 and 10. On the acid side, inactivation was immediate below 2·5 and on the alkaline side above 11·5. In the analytical ultracentrifuge, purified active suspensions gave a single fairly sharp boundary with the sedimentation constant $S_{20} = 5400 \times 10^{-13}$ cm. sec.$^{-1}$ dynes^{-1}. The elementary bodies became lighter and hence were broken down at those *p*H values at which they were immediately inactivated. The iso-electric point was determined to be between *p*H 4·3 and 4·6.

Cross-beaked Fowls

THE cross-beak condition is normal in the widely distributed genus *Loxia* and the endemic Hawaiian genus *Loxops*. In *Loxia* a straight beak occurs as a rare abnormality, while cross-beaked specimens have been recorded in many different genera and species of birds. In zebra parakeets the condition occurs repeatedly, and it has frequently been reported in domestic fowls. Dr. Walter Landauer (*J. Genetics*, 37, No. 1) has studied cross-beak in silver spangled Hamburghs, White Leghorns, Rhode Island Reds and Dark Cornish Fowl as well as other breeds. He finds that, in *Loxia* as well as the commonest type of cross-beak in fowls, the beak is normal at hatching and begins to be crossed later. In both, the beak may deviate to the right or the left side; but the condition is more variable in fowls than in *Loxia* and may involve either beak, whereas in *Loxia* it is always mainly in the lower beak. Four different types of cross-bills have been observed in chickens. Type I is associated with eye defects, Type II is found among homozygous embryos of Creeper and Japanese Bantam, Types II and IV are hereditary, the former appearing in the second month of life and the latter before hatching. In these hereditary types the upper beak is generally involved. The breeding results suggest that the genetic basis is complex in both cases. No individuals breeding true for cross-beak were obtained, and crosses between Types III and IV gave only normal offspring. A fifth type of cross-beak appears to be associated with polydactyly.

Relationships of the Fish-Hawk or Osprey

AT various times and by various authors the osprey has been regarded as most closely related sometimes to the eagles and sometimes to the kites; but the linkage has been indefinite because most of the characters used in the classification of the osprey have undergone so much adaptive modification as to be unreliable. Lawrence V. Compton, after a thorough analysis of the feather tracts (pterylosis) of the hawks, concludes that the arrangement of the tracts affords evidence of taxonomic value (*Univ. California Pub. Zool.*, 42, 173; 1938). The characters afforded by feather tracts divide the hawks into three natural groups: the Accipitrid type, the Falconid type, and the Cathartid type. The secretary bird may represent

a fourth group, although it is more closely related to the accipitrids than to the other hawks. The osprey (*Pandion*), according to its feather groupings, is most closely related to *Carthartes*, and not to the falcons, with which it has usually been placed. But its characters are sufficiently distinct to warrant its separation in a family, Pandionidæ, equivalent in rank to the family Cathartidæ, within the sub-order Cathartæ.

Sexual Reproduction of *Ranunculus Ficaria*

It is known that *Ranunculus Ficaria* seldom sets viable seed, and C. R. Metcalfe has shown that of the two forms, namely, those with and those without aerial tubercles, the latter invariably produce a higher proportion of viable seed. The author has recently made a full investigation of this phenomenon (*Ann. Bot.*, New Series, **3**, No. 9, 91; 1939). He has shown that lack of viable seeds is due chiefly to certain forms of degeneration in either the embryo-sac or the nucellus. These forms of degeneration are described. It is also shown that ovules frequently become disorganized even when active pollen tubes are present; therefore degeneration cannot be due to the lack of viable pollen. Fertilization is not essential to the formation of endosperm in normal embryo-sacs, and proof was obtained that embryos sometimes arise apomictically from unfertilized eggs. Reasons are also stated why seed which is apparently viable is not always capable of germination.

Floors for Industrial Purposes

An account of the work done in connexion with the many problems concerning floors for industrial purposes was given by R. Fitzmaurice and F. M. Lea, of the Building Research Station, before a joint meeting of the Institution of Structural Engineers and the Institution of Chemical Engineers on January 26. It was pointed out that comparative test data on the relative resistance of various materials to impact and abrasion are practically non-existent and indeed a satisfactory discriminating test has not yet been devised. The authors gave a rough classification of the usual conditions of abrasion and of the types of flooring materials in common use in the different conditions quoted. When chemical action is added to the mechanical agencies of destruction the case is more serious. There are many substances the action of which on concrete is so slow and so limited that they have been successfully stored in concrete tanks; but when assisted by abrasion on a concrete floor they give a great deal of trouble. The authors also gave details of the floor conditions found in several groups of factories in typical industries. It was pointed out that volume changes caused by variations of moisture content give a good deal of trouble as the cracks allow corrosive liquids to penetrate to the structural floor beneath, and in this connexion the authors gave data of the amount of shrinkage in the principal materials and offered some valuable suggestions for its mitigation. They also dealt with some points in relation to the structure. One of these had reference to the provision of continuous slabs extending over several beams. The reversal of the bending moment requires that the reinforcement be brought to the top. If now a top dressing is applied to the slab, the reinforcement is no longer in the right place to resist the tensile stress, and cracks occur. It is recommended, therefore, that a joint be made in the concrete finish or that additional reinforcement be provided in it.

Isotopes of Uranium and Lead

The isotopic constitution of uranium and lead has been studied by A. O. Nier (*Phys. Rev.*, **55**, 150; using a mass-spectrograph. The positive ions of these elements were produced by vaporizing salts of the metals and bombarding the vapours with electrons. Uranium from several different ores gave the isotopes U^{238}, U^{235} (abundance ratio $U^{235}/U^{238} = 1/139$) and U^{234} (abundance ratio $U^{234}/U^{238} = 1/17{,}000$). No other isotopes were found. From the abundances of these elements the decay constants of U^{238} (U I), U^{235} (AcU) and U^{234} (UII) were found. The lead from twenty-one sources was similarly examined. The isotopes of uranium lead Pb^{206}, Pb^{207}, of common lead $Pb^{208, 207, 206, 205}$, and of thorium lead Pb^{208} were found. The abundances of the isotopes agreed in general with the chemical atomic weights which have previously been used to distinguish the proportions of the different leads. The ratio between the abundance of lead from the Ac and U series (Pb^{207}/Pb^{206} corrected for common lead contamination) provides a new method of estimating the ages of minerals, and it is possible that the method would give results more reliable than the well-known determination of the Pb/U ratio in cases where the mineral has been subject to alteration. It is shown that it is very unlikely that Pb^{208} decays to Pb^{204}, as has been suggested.

Testing of Transmission Line Insulators

It is known from the annual reports on atmospheric pollution, issued by the Department of Industrial and Scientific Research, that in London and other large cities, solid deposits settle from the atmosphere at an average rate of about one ton per day per square mile. As a rule, these deposits consist of free carbon and metallic salts in various proportions. Sometimes they settle on high-tension transmission lines and on the insulators supporting them. When dry, such deposits have a comparatively high electrical resistance, but when moist the salts go into solution and the resulting damp deposit is a much better conductor. The outdoor insulators used on overhead power lines are exposed to these deposits and trouble is sometimes experienced with them causing flash-over and dangerous surges of electricity along the wires. Near the sea coast in Great Britain, both salt and industrial deposits present serious problems. In an important paper read by W. J. John, of Queen Mary College, and C. H. W. Clark to the Institution of Electrical Engineers, on February 15, this problem has been very successfully attacked both in the laboratory and in the open air. In the first case, an aeronautical wind tunnel was used through which air was drawn by a fan, the salt-spray formed by an atomizer surrounding the insulator under test, and the way in which dew was deposited on it was noted. A high-pressure supply of 33 kv. was sometimes employed and oscillographic records of the leakage surface currents were obtained. In the outdoor tests, it was found that in average good weather conditions conductance is not a measure of the deposit on the insulators used in practice, as their edges and ribs remain clean and have a high resistance. Bad weather conditions which lead to flash-over in service are fog, mist, dew and frost. On several occasions rain was accompanied by mist, and this constituted as a rule the most serious weather conditions.

The Widmanstätten Structure of Octahedral Meteoric Iron

By Prof. S. W. J. Smith, F.R.S., and J. Young

THE effect known as the Widmanstätten structure is shown most clearly in those meteoric nickel-iron alloys in which the percentage of nickel lies between certain limits, roughly, from 7 to 14. When the percentage of nickel is less than about 6·5, there is no Widmanstätten structure—the single component is known as 'kamacite'. With higher percentages of nickel, there is always an additional component—known as 'taenite'. Attempts to find its percentage composition by chemical methods led to very different results, ranging from about 25 to 37—although in one isolated case a percentage of about 47·8 was recorded. These widely varying results are due to the difficulty of isolating the taenite from the kamacite with which it is so intimately mixed and indeed often encloses. It was for this reason that it occurred to one of us to attempt to determine the composition of the taenite *in situ* by means of 'thermo-magnetic' analysis (*Phil. Trans.*, A, 1908).

For various reasons these early efforts were not so successful as they might have been. Later it was possible, in Birmingham, to repeat these experiments with more suitable meteorites than that originally examined and to add micrographic and X-ray measurements to this method of attack. For the results obtained by the latter (*Proc. Roy. Soc.*, A, 1926, etc.), one of us (J. Y.) has been almost entirely responsible; while Mr. A. A. Dee gave valuable help in the development of the former.

Of the various octahedrites examined, the Butler meteorite, containing about 10 per cent of nickel and relatively free from impurities such as phosphorus, gave the most satisfactory results. It showed in the clearest possible way that the taenite has a reversible magnetic transition temperature at about 500° C. and therefore contains approximately 50 per cent of nickel. From the way in which it forms (see below), it is unlikely that a taenite band is of uniform composition. It may be sensibly less rich in nickel at its centre than at its boundaries. In any event, the thinnest bands are most likely to be of nearly uniform composition and to give the closest approximation to the equilibrium percentage of nickel in the γ phase alloy.

In agreement with this consideration, X-ray analysis shows that the narrowest taenite bands contain the highest percentages of nickel—about 55 per cent in these and about 50 per cent in the broader bands. It does much more than this. It shows that kamacite and taenite are, apart from impurities, solid solutions of nickel and iron—the former having a body-centred and the latter a face-centred cubic lattice. The lattice parameters confirm the inference from the thermomagnetic experiments regarding the composition of taenite. Other results are particularly significant. They show that the majority of the taenite crystals have a single orientation throughout the meteorite, their {111} planes lying nearly parallel to the kamacite-taenite lamellæ. The kamacite crystals show small random deviations from the twenty-four orientations of the type; (110) kamacite parallel to (111) taenite, [001] kamacite inclined at 4° to [01$\bar{1}$] taenite. These relationships hold in both band and plessitic structures; but the deviations are greater in the latter than in the former.

A significant feature of the taenite bands, revealed by micrographic investigation, is that only the narrowest of these consist entirely of γ-phase alloy. The central regions of the broad bands often show that an independent γ-α-transition, sometimes described as 'plessite', has developed there. A characteristic feature of this development occurs where it meets the inner boundary of its taenite envelope. This boundary has a 'jagged' or serrated appearance—due no doubt to the conditions under which the last of the γ-α-transition occurs. It exhibits the traces on the surface of rational planes of the taenite containing a [110] axis, such as {111}, {100}, {110} and {211}.

One of the most interesting problems presented by the results is the magnetic behaviour of the taenite, which would have shown little, if any, magnetic evidence of its existence during the first heating experiments if a step-by-step method of heating to successively higher temperatures had not been used. X-ray analysis provides an explanation of this phenomenon. It reveals the existence in the meteorite 'as received' of a transition layer at the taenite-kamacite boundary in which the lattice spacings of planes parallel to that boundary vary continuously from that of the {111} plane of the taenite to that of the {110} plane of the kamacite. This transition layer is that at which the last of the γ-α-conversion occurs as the temperature falls. It would seem that it is the effect produced by the heat treatment upon this layer that enables the taenite to exhibit its ferromagnetism.

Very suggestive results were obtained from a study of an artificial nickel-iron alloy containing 10 per cent nickel cooled slowly from the molten state. Magnetic and X-ray analysis of this alloy showed that it consisted entirely of body-centred crystals. When, however, the alloy was heated progressively to, and annealed at, a temperature of 580° C., its subsequent behaviour indicated the presence of a γ-phase alloy containing about 30 per cent nickel. X-ray examination confirmed the presence of γ-crystals having a strongly preferred orientation, in which their {111} planes were parallel to the Widmanstätten figures in each grain, as in the meteorites. The α-crystals also exhibited twenty-four orientations differing little from those found in the octahedral meteorites. Although cooling in liquid air transformed some of the γ-phase into α, this is the nearest approach we have yet made to a reproduction of the essential features of an octahedral meteorite. Recent experiments by others support the view that a much closer reproduction would have been made by exceedingly slow cooling.

An interesting effect of the heat treatment of meteoric iron is the formation of slip planes in the taenite. These can be produced, for example, by heating to 650° C. followed by cooling in liquid air. Slip planes of the forms {111}, {100} and {110} are common and the direction of slip, when identified,

is [110]. There can be little doubt that such slip planes arise as a result of the differential contractions of the constituents when cooled and of the expansion associated with the γ-α-transformation when it occurs.

Finally, it may be of interest to summarize our views regarding the origin of the Widmanstätten structure in meteorites. It seems highly probable now that the kamacite lamellæ are the result of a γ-α-lattice-mechanical transformation. This is shown by the relationship between the orientations of the kamacite crystals and the single orientation of the taenite, and is confirmed by the fact that approximately the same relationship is found in the 10 per cent artificial alloy in which the γ-α-transformation is known to have occurred.

As is commonly held, it is quite probable that meteorites have originated during extremely slow cooling inside some massive heavenly body. In these circumstances, the lattice-mechanical transformation may have taken place so slowly that almost perfect equilibrium has obtained. From this point of view the parameter measurements of the taenite are significant—showing that the narrowest taenite bands are always richer in nickel than the broader ones. It would seem that the latter, owing to their thickness, cannot attain complete equilibrium at the lowest temperature at which effective diffusion is possible.

Acknowledgment of the contributions of many postgraduate students to the work, here outlined very briefly, will be made elsewhere. It is the fault of one of us (S. W. J. S.) that it is so much overdue.

Dimensions of Some Organic Molecules

THE forty-fourth Bedson lecture was delivered by Dr. J. Monteath Robertson to the Bedson Club at King's College, Newcastle-upon-Tyne, on January 27.

Under the title "The Dimensions of Some Organic Molecules", Dr. Robertson dealt with advances in this field, which have occurred mainly as a result of X-ray crystallography. A crystal may be regarded as a periodic structure of units containing electrons, which diffract X-rays, and from a consideration of the direction of diffracted beams, it is possible to determine the distance between these units. By a more involved analysis of the intensities of the beams, something may be learnt about the distribution of the electrons within the diffracting units, and from this, the structure of organic molecules can be investigated. The results are worked out as a two-dimensional graph of electron density, and although in general there is foreshortening owing to the molecule lying at an angle to the plane of projection, it is possible, by taking a series of projections, to obtain a true picture of the molecule in space. Upon such graphs, atoms, except hydrogen, the scattering power of which is insufficient for separate resolution, are clearly seen as circular regions of high electron density, and the peak values enable the separate atoms to be named. As a general rule, it is not possible to obtain the electron density graph without some assistance from chemical evidence, although in some cases the assistance is slight.

The results obtained may be classified under two heads; first, the qualitative confirmation of organic structures, and the refinement offered by the actual measurement of bond distances, and secondly, the information obtained with regard to the relative orientation and distance apart of the separate molecules in the crystals.

Bond measurements of organic compounds which can be represented by a unique structural formula show certain definite regularities. Both single and multiple bonds are constant in length, the atoms being nearer in multiple-bonded compounds than in single, and nearer in the case of nitrogen atoms than in the case of carbon. Bond distances between carbon and nitrogen atoms are the mean of the corresponding carbon-carbon and nitrogen-nitrogen distances. These regularities are not found where resonance is possible. In such cases, the length of a single bond may have any value intermediate between those normal for single and double bonds. In some of the simpler cases it is possible to estimate bond distances by wave mechanics, and their actual measurement provides a very important check upon these highly involved theoretical calculations. Such measurements also played a very important part in the development of the theory of resonance.

With regard to intermolecular distances in crystals, we may also distinguish two groups, normal and abnormal. In the first, typified by the hydrocarbons, the molecules appear to be arranged in the most convenient manner, without any particular order, and the distances of nearest approach are of the same order for a great many compounds. In such substances as benzoquinone, as might be expected, the dipole causes some approximation of oppositely charged atoms, but the distance of nearest approach is not greatly reduced. In the second group (abnormal), the approach distances are less by nearly an angström unit, and this applies generally to those compounds which are known to be associated in the liquid or gaseous states. In the case of resorcinol, for example, very drastic changes are found. The molecules are orientated so that the hydroxyl groups come much nearer to each other than is normal. The structure itself, however, remains open, as is shown by the fact that resorcinol is less dense than benzoquinone. This indicates the strongly directive power of the intermolecular hydroxyl 'bonds', which can maintain such an open arrangement. However, when resorcinol is heated above 74° C., thermal agitation destroys this structure, the molecules are arranged without reference to the affinities of the hydroxyl groups, and the density rises. The higher temperature form takes several weeks to revert to the other, and can be studied in the usual way, when it is found that the molecules are arranged in much the same way as in a hydrocarbon crystal. The close approach of hydroxyl groups is very common, and in the case of hydrated oxalic acid, for example, it is thought that intermolecular resonance occurs.

In conclusion, Dr. Robertson said his intention had been to show that the newer developments of X-ray crystallography enable a definite and accurate picture of the molecular structure to be obtained.

Meridian Astronomy

ON February 10, Dr. H. Spencer Jones delivered his presidential address at the Royal Astronomical Society on "Meridian Astronomy". He pointed out that the purpose of meridian astronomy is to provide a fundamental system of reference, and this is defined by the positions and proper-motions of a network of stars distributed with reasonable uniformity over the whole sky, together with the numerical value of the constant of precession. There are difficulties in the exact determination of the equator—the plane of reference—and also of the equinox—the zero point—because observations of the sun, which are used to fix these, are liable to personal errors of a systematic nature.

These latter have been reduced very considerably by the use of the impersonal micrometer in place of the hand-tapping method. A moving wire is traversed across the field at such a rate that it moves with the object under observation, and contacts are automatically closed when the moving wire reaches certain positions in the field. Personal errors in the observation of stars by the hand-tapping method could amount to a few tenths of a second, but the impersonal micrometer has reduced these to a few hundredths of a second.

Although the bright inner planets can be used for fixing the equator and equinox, the perceptible disk and phase present difficulties, and the results are unsatisfactory. The suggestion of Sir Frank Dyson that Vesta should be used to determine corrections to the equator point and equinox has much to commend it, as this minor planet has a star-like image and is observed at night, and, in addition, is sufficiently bright for observation with the impersonal micrometer. Plans have been developed for utilizing a large number of minor planets to control not only the equinox and equator point, but also errors of a systematic nature.

It is remarkable that, in spite of great improvements in the design and construction of instruments, modern catalogues of stars still show systematic differences, especially in declination, and some interesting light is thrown on the problem by the new reversible transit circle, recently provided at Greenwich. A full description of certain discordances is given, and these were sufficiently large to enable the source of the trouble to be detected. One defect, *inter alia*, may be referred to. The guiding rod, along which the frame carrying the moving wire was constrained to move, was slightly convex to the eyepiece, and the guiding slide of the tailpiece which prevented motion in a direction perpendicular to the plane of the frame formed a constraint. The removal of small amounts of metal rectified these defects, and the lag of the moving wire behind the micrometer screw is now negligible.

Determinations of the precessional constant have usually involved the assumption of random distribution of stellar motions, but the existence of two star-streams, postulated by Kapteyn, Lindblad and Oort's theory of a rotating galaxy, and Schwarzschild's view of a preferential direction of motion, are not in accordance with the assumption. In consequence, the value obtained for the precession will depend upon the assumptions that are made, and, to avoid this difficulty, it has been suggested that the distant galaxies should be used as a system of reference. If the positions of a large number of the distant galaxies were determined with reference to neighbouring stars, the positions of the latter being directly related to the fundamental star system, a means would be provided for correcting and controlling that system and also for determining the constant of precession more exactly. Here is a work for the future that promises to be of assistance for meridian astronomy.

Brittany and Britain: Prehistoric Relations

DR. R. E. MORTIMER WHEELER'S lecture on his exploration of archæological sites in Brittany last summer, which was delivered before the Society of Antiquaries of London on February 23, gave details of an investigation of which the results have been awaited with no little interest.

It will be remembered that the expedition which he described was undertaken on behalf of the Society of Antiquaries, with the support of the Leverhulme Trust and the University of London, and with the co-operation of the French authorities; and that it had as its specific object to probe the origins of the civilization, which Dr. Wheeler's excavations at Maiden Castle in Dorsetshire, and recent evidence from other sources, had shown makes its appearance with some abruptness in south-west Britain, evidently from foreign sources, in the century immediately preceding the Christian era. One of the more striking characteristics of this civilization is the adoption of what is here a new method of defence on a fortified site—multiple lines of outworks, instead of the single line of ditch and rampart universal hitherto on the Wessex Downs, and manifestly designed to meet a new weapon of attack, the sling, to the use of which the multitude of sling stones for attack and defence now bears witness.

In seeking the place of origin of this innovation, the natural line of inquiry is directed towards the opposite shores of Brittany; but Dr. Wheeler found to his surprise, on making a survey of the material of the period both in northern Brittany and in north-west Normandy, that two camps only were at all comparable to Maiden Castle. Of these one is at Huelgoat, near Morlaix, the other Le Petit Celland, near Avranches, on the Bay of Mont St. Michel. At the former, the work known as Le Camp d'Arthus was found to be of two closely related periods, dating approximately from the middle of the first century B.C. The 'Gallic' method of construction of the rampart, as described by Cæsar, and the infertile

country around point to a military or political occupation, rather than one of economic significance. It was, Dr. Wheeler concludes, a military rallying post for the peoples of the surrounding country, the Osismii, at the time of the Roman conquest. This conclusion is supported by the examination of the camp at Le Petit Celland, where the Gallic ramparts were never completed, but were destroyed by military action at a date indicated by coins of local type to coincide in time with Cæsar's campaign.

Interesting as were these discoveries, they had provided the expedition with no analogy with the complex forts of the Wessex Downs; and its activities accordingly were then directed to southern Brittany. Here on the jagged cliffs, the bays, and wooded estuaries from Douarnenez to the mouth of the Loire, the home of the Veneti, Cæsar's strenuous and troublesome opponents by land and sea, are situated more than three fourths of the fortified works of this period in north-western France. Wherever in this region digging has taken place, multiple ditches and quantities of sling-stones have appeared. "Here, and here only", to quote Dr. Wheeler, "are the true forerunners of those tumultuous defences of South-Western Britain, in which the present research originated"; and in the name of the type camp excavated, Kercaradec, he is reminded of the familiar Shropshire Caer Caradoc. Dr. Wheeler goes on to suggest that as a result of the defeat of the Veneti in Cæsar's campaign of 56 B.C., a remnant escaping from Roman vengeance for rebellion may have escaped to settle in Britain, following the earlier route already familiar to traders and prospectors who, there is evidence to show, had made their way to Cornwall.

Forest Types in India and Burma

IN a prefatory note to his monograph entitled "A Preliminary Survey of Forest Types in India and Burma" (*Ind. For. Rec.*, N.S. 1, No. 1, Govt. Press, Delhi, 1936), Mr. H. G. Champion, sylviculturist at the Dehra Dun Forest Research Institute, defines the purpose of the work. From the point of view of the average forest officer in India, Gamble's "Manual of Indian Timbers" and Brandis' "Indian Forest Trees" fulfilled ordinary requirements, to which Troup's "Sylviculture of Indian Trees" and Stamp's "Vegetation of Burma" afforded additional information. Mr. Champion's objective was different from that of forest botany pure and simple. As he correctly states, "The need of a standard classification for the important forest types of India has long been felt in connection with sylvicultural work, particularly in its application to forest management under working plans, and this need has led to the adoption of local standard types in some provinces".

In temperate Europe the forest types are comparatively few in number, and for the purposes of the working plans officer easy to define without danger of misapprehension. In the tropical and sub-tropical forest regions, the position is far more complicated. This problem had come up previously at sylvicultural conference meetings held at Dehra Dun; one of the puzzling undefined types, for example, being the term 'tropical evergreen'. Mr. Champion solicited the assistance of the provincial research sylviculturists, and as a result a certain amount of a variable material was sent in. This, with such information as had been already published, was utilized in conjunction with his own recorded observations made in all parts of India during the preceding twenty years in the compilation of the publication under review.

As the author says, working plans generally include a description of forest types with which they are concerned, and give lists of the characteristic plants of each. In the present reviewer's opinion, working plans should always include a description of the forest types, etc. But it is essential that the forest officer carrying out the provisions of the plan should know exactly the forest type or types to which the working plans officer is alluding. Herein lies the value of Mr. Champion's work. It is by no means to be regarded as complete. "The account of the Peninsular and Burma sub-tropical forest types is outstandingly incomplete", he tells us; and there are other parts in the monograph where further information is required, and the author adds that criticism of the classification adopted will be welcomed. The work is illustrated by some typical photographs, for the most part taken by past and present forest officers, also by an informative coloured diagrammatic map showing the distribution of climatic types.

The monograph comprises some 286 pages and may be regarded as a valuable aid to the forest officer engaged upon important work in forest management and working plans. A brief résumé only can be attempted here.

A classification of the forest types in India is attempted, based on four climatic zones from the point of view of temperature—tropical, subtropical, temperate and alpine. Each zone is subdivided on available moisture as reflected by the relative importance of evergreen, deciduous and thorny trees. Whilst the form of the tropical forests is similar on both sides of the Tropic of Cancer, the author considers that the flora is sufficiently different to render subdivision into northern (quasi-subtropical) and southern variations advisable. Omitting moist and dry alpine scrub, thirteen formations are distinguished, seven of them subdivided into northern and southern variations.

The six tropical formations are sub-divided into thirty-three forest types, most of which are admittedly composed of several associations, these being indicated where possible; important edaphic variants (twenty-four) are listed and successions are discussed leading to the recognition of twelve primary and ten secondary important seral types. Subtropical and temperate forests are dealt with in a similar fashion. For each type a general description of the forest and the locality factors is given, with plant lists for typical examples, and ecological notes.

The author stresses the lacunæ to be filled up; but in even its present form his monograph should be of considerable use, not only to India but in the forests of the world where similar problems are being faced.

Science News a Century Ago

The Royal Society

AT a meeting of the Royal Society on March 7, 1839, William Hopkins read the third part of his paper "On the phenomena of Precession and Nutation, assuming the Interior of the Earth to be a Heterogeneous Fluid". The objects of researches of this kind, said the author, were not merely to determine the actual state of the globe, but also to trace its past history through the succession of ages, in which the matter composing it has probably passed gradually through all its stages between a simple elementary state to that in which it has become adapted for the habitation of man. In this point of view the problem was not without value, as demonstrating an important fact in the history of the earth, presuming its solidification to have begun at the surface—namely, the permanence of the inclination of its axis of rotation, from the epoch of the first formation of an exterior crust. This permanence had frequently been insisted on, and was highly important as connected with the author's speculations on the causes of that change of temperature which had probably taken place in the higher latitudes.

A Royal Institution Conversazione

ON March 8, 1839, a conversazione was held at the Royal Institution. In its report of the meeting the *Mechanics' Magazine* said: "Mr. Read exhibited what we think to be a very important application of his patent instrument, commonly called the 'stomach pump', namely to the restoration of suspended animation. Besides extracting noxious gases in other cases, and the naturally vitiated state of the air in the lungs of drowned persons, the apparatus is competent to keep up an artificial breathing, the supply of air being both warm and pure, and rendered more exciting if thought proper, by a mixture of oxygen with it. . . . The Royal Humane Society will assuredly hasten to add this to their other means of recovery. We would advise Mr. Read to furnish with the apparatus, air tight bags, which being supplied to the extremities, and the air exhausted by the same instrument, would tend to relieve congestion of blood in the head and other parts, and facilitate its circulation."

Niepce, Daguerre and Talbot

IN its column of weekly gossip, the *Athenæum* of March 9, 1839, said: "During the discussions which took place in Paris respecting the priority of the discovery of M. Daguerre and Mr. Talbot, the name of M. Niepce was incidentally mentioned as the person to whom the former was indebted for the first idea of fixing the images represented in a camera obscura. Subsequently M. Niepce's claim to honour has been more fully admitted; and this has been singularly confirmed by Mr. Bauer, in a letter published in the *Literary Gazette*. Mr. Bauer therein states that, in 1827, he became acquainted with M. Niepce, then on a visit to his brother at Kew; that M. Niepce made known to him, and others, that he had discovered a means of 'fixing permanently, the image of any object by the spontaneous action of light', and exhibited several specimens. That by the advice of Mr. Bauer, he, M. Niepce, drew up a memoir on the subject, dated 8th December, 1827, which he forwarded to the Royal Society, but which was subsequently returned, because it is contrary to the rules of the Society, to read a paper referring to a process which is not disclosed.... Thus, then, the question of priority, as between England and France, is settled beyond all dispute: at the same time we must observe that the processes of M. Daguerre and Mr. Talbot are manifestly different."

Specimens of Niepce's work belonging to Mr. Bauer and to Mr. Cussels were submitted to the writer of this notice, who said that they were all on pewter, apparently covered with a very thin coating of transparent varnish, "but whether this varnish was applied before receiving the impressions, or subsequently, to fix them, is not obvious; we incline to the latter opinion".

University Events

CAMBRIDGE.—The Rockefeller Foundation has allocated £650 as a grant to the Cavendish Laboratory for the purchase of instruments and for assistance in connexion with researches carried out by the Cavendish Professor on the application of X-ray technique to the study of crystals of biological importance.

F. J. Scrase, of Trinity Hall, has been approved for the degree of doctor of science.

At Trinity College, Dr. A. L. Bowley, emeritus professor of statistics in the University of London, and Sir Henry Dale, director of the National Institute for Medical Research, have been elected honorary fellows.

Dr. L. Wittgenstein, formerly fellow of Trinity College, has been appointed to succeed Prof. G. E. Moore, professor of philosophy, who will retire at the end of the current academical year.

LEEDS.—The following appointments have recently been made: W. G. France, demonstrator in anatomy; Eustace A. Horne, demonstrator in pathology and bacteriology; H. S. Shucksmith, surgical tutor; Donald A. McKenzie, lecturer in agricultural bacteriology.

LONDON.—Dr. P. H. Himsworth has been appointed, as from April 1, 1939, to the University chair of medicine tenable at University College Hospital Medical School. Since 1936, he has been deputy director of the Medical Unit at University College Hospital.

The title of professor of physics in the University has been conferred on Mr. Gilbert Stead, in respect of the post held by him at Guy's Hospital Medical School, and the title of reader in physics in the University on Mr. C. T. Archer, in respect of the post held by him at the Imperial College of Science and Technology.

The following doctorates have recently been conferred: D.Sc. on Miss Irma I. Andersson-Kottö, of the John Innes Horticultural Institution; F. M. Haines, of Queen Mary College; William Pugh, of King's College; Isaac Schapera, of the London School of Economics; R. B. Cattell and S. H. Straw.

OXFORD.—In Congregation on February 27, the honorary degree of D.Sc. was conferred on Don Pio del Rio Hortega, director of the National Institute of Cancer and of the Laboratory of Normal and Pathological Histology in Madrid.

Societies and Academies

Paris

Academy of Sciences (*C.R.*, **208**, 313–396, Jan. 30, 1939).

A. CHEVALIER : Future of cotton in the [French] possessions and organization of scientific researches on this crop.

P. LÉVY : A problem of M. Marcinkiewicz.

C. EHRESMANN : The variety of plane generators of a real quadric and the topology of an orthogonal group with n variables.

L. DEHOUSSE : A differential equation for which the point $x = y = 0$ is a focus.

H. PAILLOUX : The movement of a thread on which a small ring slides.

G. SARTORY : Formation of thermal convection ascending currents above a region uniformly heated by radiation.

J. VIGNAL : Character of errors affecting levellings.

G. BECK : A theorem on the structure of the proton and of the neutron.

M. PARODI : A phenomenon of wave propagation in a line of magnets.

L. and E. BLOCH : Extension of the spectrum of tellurium into the extreme ultra-violet.

G. UNGAR : Theory of photo-dichroism.

M. E. NAHMIAS : Probable emission of mesons in certain nuclear disruptions.

F. JOLIOT : Experimental proof of the explosive disruption of the nuclei of uranium and thorium under the action of neutrons. The radio-elements formed in uranium and thorium, identified by chemists as barium or rare earths, are due to nuclear disruption with large release of energy.

MME. I. CURIE and P. SAVITCH : Radio-elements formed in uranium and thorium irradiated with neutrons. At least three radio-elements similar to the rare earths are produced, and also an alkali body of period 18 mm.

A. PORTEVIN, P. BASTIEN and L. GUILLET, JUN. : Nature and stability of some special cementites.

MLLE. M.-L. JOSIEN : Formation of bromous acid by the action of bromine on silver nitrate.

P. DUMANOIS, G. RETENAUER and M. PRETTRE : Combustion of mixtures of hydrocarbons : mixtures of decahydronaphthalene and tetrahydronaphthalene.

A. KIRRMANN : The ethylenic frequency in vinylic esters.

MLLE. B. TCHOUBAR : Action of magnesium bromide etherate on dimethyl-1.4 epoxy-1.2 cyclohexane.

A. LEMAN : Estimation of phenolic and naphtholic hydroxyl by means of benzoic anhydride.

R. PAUL and G. HILLY : Application of Raney nickel to the hydrogenation of some acids with the furanic nucleus.

A. BOUTILLIER : Reversible transformation in the copper-aluminium alloys containing between 7 parts and 16 parts in a hundred of aluminium.

F. D. LA TOUR : Dilatation and polymorphism in the fatty acids.

R. SOYER : The fallen cliff at Ivry-sur-Seine (Seine).

M. LEFÈVRE and P. BOURRELLY : Stability of ornamentation in species of the genus *Pediastrum* Meyen.

L. EMBERGER : Structure of the flower of the Polygonaceæ.

H. HUMBERT : An aberrant type of *Cæsalpinia* of Madagascar.

R. HEIM : Existence of a group of *Boletus* [fungi] with free tubes.

A. DE CUGNAC and H. BELVAL : Nature of the glucide of a hybrid between two genera of Graminee differing in their glucidic reserves.

R. DUGHI : Domain of stability of lichen symbiosis : enantioxery [resistance to drought].

P. DE BERREDO-CARNEIRO : Curarization and chronaxy.

L. LAPICQUE : Observations on the preceding note.

F. RATHERY, M. DÉROT and P.-M. de TRAVERSE Consecutive hypoglycæmia with digestive absorptio of insulin. Effects were obtained, but not proportional to the quantity of insulin used, by limiting the action of proteolytic ferments with an antidiastase.

MLLE. M. HAMON : Chemical constituents of the envelopes of cephalopod spermatophores.

L. LESCŒUR : Variations of the formol and phthalein acidities in the urine : interpretation by the graphic method.

L. LUTZ : Soluble ferments secreted by hymenomycete fungi : conjugated antioxygen action.

A.-R. PRÉVOT : Increase of the toxigenous power of a stock of *Plectridium tetani* by passage in acid brain broth at moderate temperature.

Budapest

Hungarian Academy of Science, January 23.

J. BARTA : Uniformly stretched and optionally loaded plates.

J. BARNÓTHY and M. FORRÓ : Influence of meteorological factors upon the intensity of cosmic ray showers. From the material measured during a year, the barometric, temperature and magnetic effects are determined as well as the phase and amplitude of the daily and sidereal wave. The differences between these values and those obtained with a corresponding vertical arrangement can even be quantitatively explained with the help of the meson disintegration hypothesis.

Prague

Czech Academy of Sciences and Arts, January 21, 1938.

K. HRUBÝ : Development of the embryo-sac in *Erythronium dens canis* F.

March 11.

J. MILBAUER : Prolonged action of concentrated sulphuric acid on acetylene in the cold. The solutions turn yellow to dark. This change is catalysed positively by $HgSO_4$, SeO_2, $CuSO_4$, V_2O_5, Ag_2SO_4, MoO_3; practically inert are As_2O_3, SiO_2; negative catalysts are Sb_2O_3, $PbSO_4$, HCl, $ZnSO_4$, SO_2, K_2SO_4, $(NH_4)_2SO_4$.

J. PETRBOK : Historical evolution of the bay at Neseber.

A. VELICH : Effect of essential oils on the germinating grain and bacterial growth.

May 20.

J. MILBAUER : New behaviour of mannitol as a negative catalyst. It retards the oxidation of hydrogen or ferrous sulphate by hot sulphuric acid, but not that of carbon monoxide.

V. TRKAL : A fundamental equation of the electron theory.

ZD. KÖCHER: Experimental studies of the resorption of K-strophantin and convallamarin.

ZD. KÖCHER: A contribution to the study of the accumulative effect of some cardiacs.

R. RŮŽIČKA: A contribution to the recognition of Barrandian trilobites. (2).

K. KOUTSKÝ: Some modifications of given topology.

ZD. ROTH: Geological conditions around Lučivná below High Tatra.

October 21.

J. MILBAUER: Dissociation of urea nitrate in aqueous solution.

J. MILBAUER: Application of Bunsen's photometer in enlargements.

J. MILBAUER and ZD. MILBAUER: The investigation of some relationships in the action of acetylene on sulphuric acid, at room temperature. The factors influencing this reaction. Concentration of sulphuric acid, of the positive catalyst, $HgSO_4$, and of the negative catalyst $(NH_4)_2SO_4$ are expressed by empirical mathematical formulæ.

J. MLÉKOVSKÝ: Registration of the reaction of frog's iris to light.

J. PETRBOK: Stratigraphic chronology of non-marine layers of the Black Sea quaternary in Bulgaria.

K. KAVINA: Antholysis in *Cerastinum Cæspitosum*.

P. ČECH: The electromagnetic field of a dipole between two parallel planes.

Forthcoming Events

[*Meetings marked with an asterisk are open to the public.*]

Monday, March 6

UNIVERSITY OF LEEDS, at 5.15.—Prof. E. D. Adrian, F.R.S.: "Manifestations of Activity in the Nervous System".*

UNIVERSITY COLLEGE, LONDON, at 6.—Prof. A. Frey-Wyssling: "The Submicroscopic Morphology of Protoplasm and its Derivatives (succeeding lectures on March 7 and 9).*

Tuesday, March 7

WELLCOME RESEARCH INSTITUTION, at 5.30—Prof. W. Schulemann: "Chemotherapy" (succeeding lectures on March 8 and 9).*

Friday, March 10

ROYAL INSTITUTION, at 9.—Dr. W. H. Hatfield, F.R.S.: "New Researches in Steel Metallurgy".

INSTITUTE OF METALS, March 8–9.—Annual General Meeting at the Institution of Mechanical Engineers.

Appointments Vacant

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:

TEACHER OF SCIENCE OR ENGINEERING in the Luton Technical College—The Director of Education, Shire Hall, Bedford (March 6).

PROFESSOR OF PHYSICS AND ELECTRICAL ENGINEERING in the Royal Naval College, Greenwich—The Director, Education Department, Admiralty, London, S.W.1 (March 15).

LECTURER IN PHYSICS in the University of Sydney—The Registrar (May 1).

ASSISTANT in the Intelligence Section of the Mineral Resources Department of the Imperial Institute—The Establishment Officer.

Reports and other Publications

(*not included in the monthly Books Supplement*)

Great Britain and Ireland

Two Lectures on the Development of the Chemistry of Commercial Synthetic Dyes (1856–1938). By Dr. Frederick Maurice Rowe. Pp. 106. (London: Institute of Chemistry.) [72

Proceedings of the Royal Irish Academy. Vol. 45, Section A, No. 1: A Small Scale Differential Analyser, its Construction and Operation. By H. S. W. Massey, J. Wylie, R. A. Buckingham and R. Sullivan. Pp. 22+5 plates. 2s. Vol. 45, Section A, No. 2: Note on Group Theory and Kinematical Relativity. By W. H. M'Crea. Pp. 23–30. Vol. 45, Section A, No. 3: Long Range Forces between Hydrogen Molecules. By H. S. W. Massey and R. A. Buckingham. Pp. 31–46. 1s. Vol. 45, Section A, No. 4: Diffusion and Fall of Atmospheric Condensation Nuclei. By J. J. Nolan and P. J. Nolan; with an Appendix by P. G. Gormley. Pp. 47–64. 1s. Vol. 45, Section B, No. 3: The Local Glaciers of Mount Leinster and Blackstairs Mountain. By A. Farrington. Pp. 65–72. 1s. Vol. 45, Section B, No. 4: The Silurian Inlier of Lisbellaw, County Fermanagh, with a Note on the Age of the Fintona Beds. By J. C. Harper and J. J. Hartley. Pp. 73–88+plates 13–16. 2s. 6d. Vol. 45, Section B, No. 5: Reports from the Limnological Laboratory. 4: The Phytoplankton of the River Shannon and Lough Derg. By R. Southern and A. C. Gardiner. Pp. 89–124+plates 17–21. 3s. Vol. 45, Section B, No. 6: On the Identity of *Mesilopora* Nicholson and Etheridge, 1879, with *Cladochonus* McCoy, 1847. By Dorothy Hill and L. B. Smyth. Pp. 125–138+plates 22–23. 1s. 6d. (Dublin: Hodges, Figgis and Co., Ltd.; London: Williams and Norgate, Ltd.) [72

The College of the Pharmaceutical Society. Annual Report of Research Work, 1938. Pp. 41. (London: Pharmaceutical Society.) [82

Report for 1938 (No. 51) of the Marine Biological Station at Port Erin, Isle of Man. Drawn up by Dr. R. J. Daniel. Pp. 36. (Liverpool: University Press of Liverpool; London: Hodder and Stoughton, Ltd.) 1s. 6d. net. [82

Other Countries

Indian Forest Records (New Series). Silviculture, Vol. 3, No. 2: An Investigation into the Best Date of Stump Planting Teak (*Tectona grandis*) at Begur (Wynaad Division), Dhoni (Palghat Division), and Topslip (South Coimbatore Division). By A. L. Griffith. Pp. iii+17–46+2 plates. (Delhi: Manager of Publications.) 1.8 rupees; 2s. 3d. [62

University of California College of Agriculture: Agricultura Experiment Station. Circular 347: The Water-Culture Method for Growing Plants without Soil. By Prof. D. R. Hoagland and D. I. Arnon. Pp. 40. (Berkeley, Calif.: University of California.) [72

Bulletin of the Bingham Oceanographic Collection. Vol. 6, Art. 6: Further Observations on Penaeids of the Northern Gulf of Mexico. By Martin D. Burkenroad. Pp. 62. (New Haven, Conn.: Yale University.) [72

Proceedings of the American Academy of Arts and Sciences. Vol. 73, No. 1: Poetry and Music; Musical Interpretation; and some Remarks about American Orchestras. By Serge Koussevitzky. Pp. 4. 35 cents. Vol. 73, No. 2: American Policies in the Far East. By W. Cameron Forbes. Pp. 5–28. 70 cents. (Boston, Mass.: American Academy of Arts and Sciences.) [72

U.S. Department of the Interior: Office of Education. Bulletin, 1937, No. 38: Vocational Education and Guidance of Negroes; Report of a Survey conducted by the Office of Education. By Ambrose Caliver. Pp. x+137. 20 cents. Bulletin, 1938, No. 5: Bibliography of Research Studies in Education, 1936–1937. By Ruth A. Gray. Pp. xiv+373. 35 cents. Vocational Education Bulletin No. 196 (Home Economic Series No. 22): Homemaking Education Program for Adults. By Mary S. Lyle and Rua Van Horn. Pp. vi+125. 15 cents. (Washington, D.C.: Government Printing Office.) [72

Smithsonian Miscellaneous Collections. Vol. 97, No. 12: The Spence Shale and its Fauna. By Charles Elmer Resser. (Publication 3490.) Pp. 29+6 plates. (Washington, D.C.: Government Printing Office.) [72

Western Australia. Annual Progress Report of the Geological Survey for the Year 1937. Pp. 24+5 plates. (Perth: Government Printer.) [72

Fondation Universitaire. Dix-huitième Rapport annuel, 1937–1938. Pp. xxiii+159. (Bruxelles: Fondation Universitaire.) [72

Indian Academy of Sciences. Sir Chandrasekhara Venkata Raman, 1888—7th November—1938: Jubilee Volume of Original Papers presented in commemoration of his Fiftieth Birthday. Pp. ii+243–566+14 plates. (Bangalore: Indian Academy of Sciences.) [72

Havsforskningsinstitutets Skrift. No. 112: Vattenståndsvärden 1935 och 1936. Av S. E. Stenij. Pp. 92. No. 118: Jahreszeitlicher Verlauf der chemischen und biologischen Faktoren im Meerwasser bei Hangö im Jahre 1935. Von Kurt Buch und Stina Gripenberg. Pp. 26. No. 119: Havsforskningsinstitutets verksamhet under år 1937. Av Gunnar Granquist. Pp. 16. No. 120: Regular Observations of Temperature and Salinity in the Seas around Finland, July 1936–June 1937. By E. Palmén. Pp. 44+vi. No. 122: Zur Kenntnis der Temperatur und des Salzgehaltes des baltischen Meeres an den küsten Finnlands. Von Gunnar Granquist. Pp. 166+xxxii+3 plates. Havvattnets Temperatur och Salthalt uti Finlands Kustvatten. Pp. 64. (Helsingfors: Havsforskningsinstitutet.) [72

U.S. Treasury Department: Public Health Service. Changes in the Types of Visual Refractive Errors of Children: a Statistical Study. By Antonio Ciocco. (Reprint No. 1980 from the Public Health Reports, Vol. 53, No. 35.) Pp. 8. (Washington, D.C.: Government Printing Office.) 5 cents. [82

Publications of the Kapteyn Astronomical Laboratory at Groningen. No. 49: Spectroscopic Absolute Magnitudes of Mount Wilson Contributions No. 511 and their Probable Errors. By Prof. Dr. P. J. Van Rhijn. Pp. ii+31. (Groningen: Hoitsema Brothers.) [82